IDENTIFICATION OF POTENTIALLY RESPONSIBLE PARTIES FOR CHROMIUM GROUND WATER CONTAMINATION IN OPERABLE UNIT 1 OF THE PUCHACK WELL FIELD SUPERFUND SITE

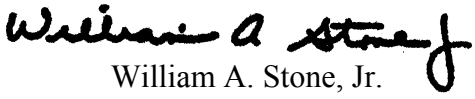
Prepared for

United States Environmental Protection Agency
On behalf of
SL Industries, Inc. and
SL Surface Technologies, Inc.

Prepared by

ENVIRON International Corporation
Princeton, New Jersey

January 2008
Project No. 02-16714A



William A. Stone, Jr.
Principal

C O N T E N T S

C O N T E N T S
(continued)

APPENDIX

TABLES

C O N T E N T S
(continued)

FIGURES

C O N T E N T S
(continued)

PLATES

I. INTRODUCTION

A. Background and Scope

ENVIRON International Corporation (ENVIRON) was retained by outside counsel on behalf of SL Industries, Inc. (SL), the current owner, and SL Surface Technologies, Inc., the former operator, of certain real property located at 482 Cove Road, Pennsauken, New Jersey (the "Site"). For purposes of this Report only, SL Industries, Inc. and SL Surface Technologies, Inc. are collectively referred to as "SL".

ENVIRON was asked to determine whether there is credible evidence that entities other than SL are Potentially Responsible Parties (PRPs) for the chromium ground water contamination at issue in Operable Unit 1 (OU1) of the Puchack Well Field Superfund Site. Thus far, USEPA has named SL as the sole PRP for OU1, despite the finding of the New Jersey Department of Environmental Protection (NJDEP) that numerous other entities contributed to the OU1 ground water contamination. During a February 12, 2007 meeting with SL representatives and in follow-up correspondence regarding the Site, USEPA indicated that SL could submit information identifying other PRPs for the Puchack Well Field Superfund Site for USEPA's review and consideration.

As discussed in detail below, there is substantial credible evidence that the following entities should be named as PRPs for OU1: (1) the Pennsauken Sanitary Landfill (the "Landfill" or the "Pennsauken Landfill")[1]; (2) the Pennsauken Sewerage Authority (the "PSA"); (3) Aluminum Shapes, L.L.C. (Aluminum Shapes); (4) MPC Industries, Inc. (MPC); (5) Weyerhaeuser Company, Inc. (Weyerhaeuser); (6) King Arthur, Inc. (King Arthur); (7) Penler Anodizing, Inc. (Penler); (8) Fisher Development Co./Boise-Cascade, Inc. (Fisher Development/Boise-Cascade) (9) C.J. Osborn Chemicals, Inc./Cook Composite (CJ Osborn); (10) DeSoto, Inc. (DeSoto); (11) Elco Varicircuits (Elco); (12) Garden State Motor, Inc. (GSM); (13) Superior Varnish Co. (Superior Varnish); (14) Donut Management, Inc. (Donut Management); (15) United Steel and Wire (US&W); (16) Natico, Inc. (Natico); and (17) Reconditioned Motor Parts (RMP). Figure 1 shows the location of these entities.

The Puchack Well Field and OU1 are located within a portion of Pennsauken Township that has been subject to intensive industrial activities for at least 70 years, beginning shortly following World War II. In light of the markedly industrialized nature of this area, publicly

[1] For purposes of this report and unless otherwise individually specified, a reference to "Landfill" or "Pennsauken Landfill" includes all the following prior and current owners and operators of the Landfill: (1) Ward Sand and Materials Company; (2) Ward Sand & Gravel, Inc.; (3) the Township of Pennsauken; (4) Pennsauken Solid Waste Management Authority; and (5) the Pollution Control Financing Authority.

available information regarding industrial activities in the vicinity of the Puchack Well Field was evaluated to: (1) identify those facilities in Pennsauken Township at which chromium was used as part of site operations; (2) determine how chromium-bearing materials were stored, handled and disposed of at those facilities, including via wastewater discharges to the PSA sewer system; (3) determine whether chromium-bearing materials may have been released to the environment; and (4) analyze data regarding any resulting adverse environmental impacts for chromium discharges. Through this task, ENVIRON identified the following seven industrial facilities, at which there is evidence that chromium was released to the environment through direct discharges to the environment (e.g., through discharge of plating wastewater to an unlined lagoon or to the ground surface) and/or where environmental media sampling results confirm on-site chromium contamination: the Landfill, the PSA system and Sewerage Treatment Plant, Aluminum Shapes, King Arthur, MPC, Penler, Weyerhaeuser and Fisher Development/Boise-Cascade.

ENVIRON also completed an evaluation of the condition of those portions of the PSA sewer system that are located within or discharge to system components located within the Puchack Well Field and OU1 to determine whether chromium-laden industrial discharges, transported through those lines since the 1950s, may have contributed to ground water contamination. Through this assessment, ENVIRON confirmed that the majority of the sewer lines within the area of interest are constructed of clay and are located above the water table. Further, ENVIRON determined that certain of these lines, including lines adjacent to the Puchack Well Field, and otherwise within the OU1, have documented historical losses in integrity with corresponding significant rates of infiltration/inflow, with even higher rates of exfiltration possible. Given the documented presence of no less than 12 industrial entities that released chromium-bearing wastewater to the PSA sewer system, it is likely that chromium was released from the PSA sewer system to the underlying ground water. In fact, CDM Federal Corporation, Inc. (CDM) and the NJDEP independently concluded that the PSA sewer system was a PRP for the chromium contamination in OU1 based on information they reviewed beginning in the 1980s.

ENVIRON additionally examined the PSA's former wastewater sludge management practices at its Sewerage Treatment Plant located on River Road. The PSA managed wastewater sludge on bare ground, which would have enabled chromium discharges to soils and underlying ground water. Chromium concentrations in the PSA sludge ranged from 88 to 6,920 milligrams per kilogram (mg/kg), averaging 4,612 mg/kg. This information indicates that the PSA likely contributed to OU1 ground water contamination. This finding has not been confirmed as there is no testing data for the soil or ground water in the location of the PSA's wastewater sludge handling areas. This is a significant data gap that needs to be filled as an essential part of any PRP investigation.

Based on the findings that numerous facilities, including the PSA, released chromium to the environment in the vicinity of the Puchack Well Field and within OU1, ENVIRON used the ground water flow model developed by the United States Geological Survey (USGS) for USEPA related to OU1 to determine which of those facilities had been located within the capture zone of the Puchack Well Field over time. This effort yielded critically relevant new information that USEPA and USGS have never previously reviewed.

As part of its prior analysis of ground water conditions in OU1, the USGS used its model to determine the capture zone of the Puchack Well Field using pumping rates for 1995, a time when only one well (Puchack #1) was pumping, at a reduced rate as part of an interim containment remedy. The USEPA used the results of this analysis as the foundation for its identification of SL as the sole PRP for OU1, as well as for its premature conclusion that the Pennsauken Landfill and industrial sites at which chromium was used and discharged could not have contributed to the chromium contamination in OU1. However, the modeling results reveal that the ground water flow regime in 1995 was materially different from the flow patterns evident during the 1950s-1980s when the Puchack Well Field was a primary regional water supply source. Accordingly, the USGS capture zone analysis did not provide a representative assessment of the zone of influence of the Puchack Well Field over time, and thus, provided an incomplete and inaccurate understanding of industrial facilities and other sites from which chromium contamination was likely captured by the Puchack Well Field. The USEPA lacked material scientific data when it reached its conclusions about PRPs for OU1.

ENVIRON therefore completed additional capture zone analyses using the USGS model and the historic pumping rates from the late 1940s through the 1980s provided by the USGS for the Puchack Well Field and other local well fields (e.g., the Morris and Delair Well Fields). ENVIRON also performed particle tracking, again using the USGS model, for those industries at which there is clear evidence of chromium releases to the environment based on information regarding industrial operations, as well as historical soil and ground water sampling data. Based on the currently available analytical data and other information, ENVIRON's evaluation confirmed that a number of these chromium-discharging facilities were located within the Puchack Well Field's capture zone. As discussed herein, the combined information of confirmed releases of chromium to the environment and location within the capture zone of the Puchack Well Field confirms that the USEPA should identify the following facilities as PRPs for OU1: (1) the Pennsauken Landfill; (2) the PSA; (3) Aluminum Shapes; (4) MPC; (5) Weyerhaeuser; (6) King Arthur; (7) Penler; (8) Fisher Development/Boise-Cascade; (9) C.J. Osborn; (10) DeSoto; (11) Elco; (12) GSM; (13) Superior Varnish; (14) Donut Management; (15) US&W; (16) Natico; and (17) RMP.

II. GROUND WATER MODELING

A. Introduction

Ground water modeling performed by the USGS formed the basis for USEPA's decision to identify SL as the sole PRP for OU1 of the Puchack Well Field Superfund Site. However, based on personal communication with Darryl Pope of the USGS, ENVIRON has confirmed that the presentation of ground water modeling performed by the USGS, and the results presented to the USEPA, were unduly limited in scope. As such, the USEPA has based its decision to name SL as the sole PRP on an incomplete and artificially limited analysis of the historic ground water flow of the Puchack Well Field.

Contrary to the limited scope of the USGS's modeling efforts, ENVIRON's more comprehensive analysis determined that significant changes to the geometry of the Puchack Well Field's capture-zone have occurred over time. The ENVIRON capture zone analysis revealed that for the years 1960 to 1995, the Well Field captured sources of known soil/ground water chromium contamination from the Landfill and from industries other than SL. The capture zone analysis confirmed that for each of the industries investigated and the Landfill, capture occurred as early as the first known year in which each of the respective industries and the Landfill began their respective operations. In addition, ENVIRON's more comprehensive capture zone analysis determined that the Well Field through its operational history captured portions of the PSA sewer system that had documented compromised integrity and high rates of leakage that likely caused chromium ground water contamination. Further, the PSA's sludge handling practices at its Sewage Treatment Plant contributed to ground water contamination captured by the Puchack Well Field. Consequently, ENVIRON's more comprehensive capture zone analysis demonstrates that the USEPA's identification of SL as the sole PRP for OU1 was premature and was not based upon reasonably available scientific and factual evidence.

B. Model

Simulations performed by ENVIRON as part of this analysis of ground water flow were based on the USGS ground water flow model (Pope and Watt 2004 USGS SIR 2004-5025). The input files for the MODFLOW simulations were unchanged between the USGS calibrated model and the model simulations presented here, with the exception of changes to the pumping stresses to represent the pumping in specific years. Inputs for the pumping were obtained from electronic files representing pumping history at nearby wells and well fields. These files were obtained through a FOIA request to the USGS and the data were validated against published tables of

USGS state water use database extracts representing pumping histories at those well fields (USGS OFR 89-402, and USGS WRIR 87-4038).

The USGS Model is discretized into 85 rows, 108 columns, and 11 layers. Figure 2 shows the model grid in plan view and the associated pumping centers. The USGS calibrated the model using water levels from the 1998 USGS measurements (Walker, 2001, USGS WRIR00-4012). Boundary conditions for the model on the Northern, Southern, and Eastern side are based on The Camden Regional Model (Navoy and Carleton, 1995) run with regional pumping information representing statewide pumping for 1998.

This analysis simulates the historic capture zones for the Puchack Well Field. Steady-state simulations were run. Particle tracking was then used to delineate the capture area for the Puchack Well Field. Steady-state simulations were analyzed for the following years: 1960, 1965, 1970, 1975, 1980, 1985, 1990 and 1995. Boundary conditions representing the Delaware River and the Camden Regional Model were left unchanged. To validate the modeling performed as part of this analysis, a comparison was made between the 1995 USGS calibrated model output files and output from the 1995 steady state model run. It was found that hydraulic heads matched precisely and water budgets were in agreement.

C. Pumping Stress

The operational history of the Puchack Well Field and surrounding well fields has evolved over time to meet water use demands. Significant differences in pumping can be seen over time as capacity in each well field is increased. These changes had a material impact on the zone of influence and ground water flow at and around the Puchack Well Field.

Figure 3 shows the operational history of the Puchack, Delair and Morris Well Fields from 1940 through 1998. Until 1978, the Puchack Well Field is the dominant producer of the three well fields. As wells in the Puchack Well Field were taken off line, additional capacity was gained at the Morris Well Field. Accordingly, analysis of 1998 water levels, pumping and resultant capture by the Puchack Well Field is not representative of historic conditions that resulted in the chromium contamination of OU1.

Water use data back to 1940 were available for evaluating changes in pumping at the relevant well clusters. Table 1 lists the wells and the assigned model stresses due to pumping at each well for simulations analyzed by ENVIRON. Water-use data for Figure 3 and Table 1 and the simulations were based on a file obtained from the USGS via FOIA request. The data were validated against published USGS Reports WRIR 87-4038 and OFR 89-402.

INSERT TABLE 1 HERE

D. Capture Zones

Significant changes to the geometry of the Puchack Well Field capture zone have occurred over time. Transport of chromium to the Well Field occurred due to the capture of sources of chromium contamination in the soil or ground water. Capture zones were constructed with MODPATH (Pollock, 1994). MODPATH requires the flow field from a simulation and an initial particle distribution. MODPATH then tracks the movement of those particles along advective path lines. Tracking can be done as "backward particle tracking" or "forward particle tracking". Backward particle tracking is used to reconstruct the historic capture zones for the Puchack Well Field. Forward particle tracking is used to reconstruct where the water is going to from the initial position (identification of advective transport path from source to receptor).

The initial particle distribution used to delineate the capture zone for the Puchack Well Field in this analysis is a circle of particles surrounding the well cluster. This circle is repeated at each layer of the model so that the initial distribution of particles is effectively a cylinder surrounding the well.

Figures 4 through 11 show the Puchack Well Field capture zones for 1960, 1965, 1970, 1975, 1980, 1985, 1990 and 1995. Significant changes to the geometry of the Puchack Well Field capture zone are a result of changes in pumping at nearby well clusters, and changes in pumping at the Puchack Well Field. Specific industrial sites with known chromium ground water and/or soil contamination are captured by the Puchack Wells during the period from 1960 to 1995.

Specifically, documented high concentration of chromium contamination in ground water and soil is present at and in the vicinity of the Pennsauken Landfill, Aluminum Shapes, MPC, Weyerhaeuser, King Arthur, Penler and Fisher Development/Boise-Cascade (see Section III for additional information regarding each of these entities). The first year of known operations for these industries was in approximately 1965 for the Pennsauken Landfill, 1964 for Aluminum Shapes[2], 1963 for MPC, 1950 for Weyerhaeuser, 1968 for King Arthur, 1965 for Penler and 1967 for Fisher Development/Boise-Cascade. Figures 12 – 18 show transport pathlines to the Puchack Well Field from each of these industries during the first year of their respective years of operation. Ground water from each of these industries was captured during the first year of operations. Figures 19 - 26 show transport pathlines to the Puchack Well Field from these known sources of chromium contamination at five-year increments from 1960 through 1995. As shown, ground water from these sources was captured by the Puchack Well Field during the entire 35-year period investigated.

[2] 1964 is the first year in which Aluminum Shapes has admitted using chromium as part of its industrial operations, although it initiated industrial operations at the site in 1957.

Figure 27 illustrates that sewer lines of suspect integrity which conveyed wastewater containing chromium were also within the capture zone of the Puchack Well Field throughout the entire period of evaluation.

Finally, the simulations performed by ENVIRON indicate that the sludge drying beds at the PSA Sewerage Treatment Plant are within the capture zone of the Puchack Well Field throughout their operation. Figure 28 shows the transport pathlines to the Puchack Well Field from the PSA's sludge drying beds for 1955, the first year of known operations for the treatment plant. Ground water from the sludge drying beds was captured during this year. Figure 29 shows an ammonia plume that existed from 1998 through 2001 in OU1 that is attributable to the PSA's Sewerage Treatment Plant formerly located on River Road. Forward particle tracking representing flow conditions in 1995 clearly demonstrates that ammonia discharges to ground water from past practices at the PSA's former Plant reached the Puchack Well Field. Based on the quantities of chromium discharged to the treatment plant, as documented in Section III, it is likely that chromium, which was also present in the sludge and effluent water, would have contributed to the chromium in ground water at OU1.

As indicated in the figures presented above, simulations performed by ENVIRON for the years 1960 to 1995 show capture of sources of known soil/ground water chromium contamination from the following entities during the Well Field's operational history: the Landfill, Aluminum Shapes, MPC, Weyerhaeuser, King Arthur, Penler, Fisher Development/Boise-Cascade, and the PSA sewer system and Sewerage Treatment Plant. Since the PSA sewer system was within the Puchack Well Field's capture zone, the following industrial entities that discharged chromium-laden wastewater to the sewer system are also PRPs for OU1: CJ Osborn, DeSoto, Donut Management, Elco, GSM, Natico, RMP, Superior Varnish and US&W.

III. POTENTIALLY RESPONSIBLE PARTIES

A. Introduction

Based on the new data obtained from modeling and recent investigative efforts, ENVIRON identified additional PRPs for OU1, including the PSA, the Pennsauken Landfill and a number of industrial entities. The locations of these PRPs are shown on Figure 1.

The PSA is a PRP because of its ownership and operation of a leaky sewer system and treatment plant that caused discharges of hazardous substances to the environment during the relevant time period. However, the PSA's operation of a leaky sewer system implicates far more than itself as a PRP. The PSA's sewer system and sludge drying beds are also mechanisms by which hazardous substances from large quantities of contaminated industrial wastewater were discharged into the environment at and around the Puchack Well Field and the chromium plume being addressed in OU1. A detailed discussion of the relevant facts and evidence concerning the PSA and the sewer system is contained in Section III.B.1 of this report.

The PRPs for OU1 identified in this report fall into three categories, as summarized on Table 2. The first category consists of the following entities that are PRPs because of both (1) the impact of their on-site chromium discharges to the environment within the capture zone of the Puchack Well Field during the relevant time period, and (2) their chromium discharges through compromised sections of the PSA sewer system during the relevant time frame: the PSA, Aluminum Shapes, King Arthur, and Penler. The second category includes the following entities that are PRPs because of documented adverse environmental impacts from their on-site chromium discharges: the Pennsauken Landfill, MPC, Weyerhaeuser and Fisher Development/Boise-Cascade. The final category of PRPs includes entities named because they discharged chromium via compromised PSA sewer lines: CJ Osborn, DeSoto, Donut Management, Elco, GSM, Natico, RMP, Superior Varnish and US&W. The PRPs in each of these categories are individually discussed in greater detail in Sections III.B.1.d. and III.B.2 through III.B.8 of this report.

TABLE 2
Summary of Identified Potentially Responsible Parties
OU1 of the Puchack Well Field Superfund Site
Pennsauken Township, Camden County, New Jersey

PRP Category	Description	PRPs
1	Entities that both discharged chromium to on-site soils and/or ground water as well as to/from the PSA sewer system	Pennsauken Sewerage Authority Aluminum Shapes, L.L.C. King Arthur, Inc. Penler Anodizing, Inc.

TABLE 2
Summary of Identified Potentially Responsible Parties
OU1 of the Puchack Well Field Superfund Site
Pennsauken Township, Camden County, New Jersey

PRP Category	Description	PRPs
2	Entities that discharged chromium to on-site soils and/or ground water	Pennsauken Landfill MPC Industries, Inc. Weyerhaeuser Company, Inc. Fisher Development/Boise-Cascade
3	Entities discharging chromium to the PSA sewer system	CJ Osborn Chemicals Inc./Cook Composite DeSoto, Inc. Donut Management Elco Varicircuits Garden State Motors, Inc. Natico, Inc. Reconditioned Motor Parts, Inc. Superior Varnish Co. United Steel and Wire, Inc.

B. Documented Sources Of Chromium Soil And Ground Water Contamination In The Vicinity Of The Puchack Well Field

1. The PSA

ENVIRON completed an analysis of the Pennsauken Sewerage Authority (PSA) sewer system in the vicinity of the Puchack Well Field and OU1 to document the conditions of the system, and to specifically identify sections of the sewer system that through leakage likely contributed to the chromium documented in ground water. ENVIRON'S investigations revealed that certain portions of the PSA sewer system in the vicinity of the Puchack Well Field and OU1 were documented as having significant infiltration and inflow rates, indicating that significant losses of integrity were present in much of the PSA sewer system and that similarly significant rates of exfiltration from those portions of the sewer system were also likely. The relatively advanced age and loss of integrity of much of the PSA sewer system has material implications related to the impact that the system likely has had on ground water quality within and around the Puchack Well Field and OU1.

a. History of the Pennsauken Sewer System in the Vicinity of the Puchack Well Field

ENVIRON obtained extensive information regarding the history, nature and condition of the PSA sewer system from several sources. Pennsauken witnessed rapid development during the period of 1880 – 1900 and a second wave of development during 1920 – 1930 (Survey of Camden County, Camden County Historical Society, 2002). Most of the initial development in the township is believed to have occurred during these periods. Commercially available online real estate resources (i.e.,

www.RealQuest.com) indicate that the area of Pennsauken in the vicinity of Puchack Well Field was initially developed during the 1920s-1930s. It is believed that the sewer system in Pennsauken was likely installed during this period of time. Industrial development in the area occurred following World War II, with additional sewer lines likely installed at that time. The PSA was established in 1950 and the new sewage treatment plant located at River Road started operation in 1955. Several sewer line sections were added to the system during the period from 1950 to 1960.

The evidence shows that the majority of sewer lines within and around the Puchack Well Field and OU1 were made of clay. Vitrified clay was the common pipe material used for smaller-diameter sewers installed during the early part of the twentieth century. Typically, the pipe joints were made by placing a gasket made from a piece of jute or oakum soaked in cement grout around the end of the pipe. The joints were then filled with cement mortar and covered with cheese cloth. Any settlement or shifting of pipe would cause these types of rigid joints to crack and often resulted in excessive leakage in the sewer systems.

b. Condition of the Pennsauken Sewer System in the Vicinity of the Puchack Well Field

The early 20th-century practice of using clay for the construction of sewer lines and the documented structural failures associated with such lines was confirmed by multiple studies of the PSA sewer system prepared on behalf of the PSA and the Camden County Municipal Utilities Authority (CCMUA).

In 1980, the CCMUA retained Weston, Speitel and Watermation (WSW) to complete an infiltration and inflow study that included the service area of the PSA. In 1982, the PSA engaged Remington Engineers, Inc. (Remington) to prepare plans and specifications for the cleaning, repairing and television surveying of certain sanitary sewer mains within the PSA system. The specific mains identified for this evaluation were those that, according to Remington, required frequent maintenance to address blockages. Less than one year later, the PSA again retained Remington to perform an infiltration and inflow study of the entire PSA system to identify sections of the sewer lines that were experiencing atypically high rates of infiltration and inflow. Alaimo was also retained by the PSA to complete a television inspection of sewer lines to determine the specific causes of service disruptions. Through these investigations, detailed information was obtained regarding the construction of the sewer system and the conditions of many of the sewer lines servicing Pennsauken.

The PSA sewer system is divided into individually numbered subsystems based on the area serviced by the individual pump stations or trunk sewers. Plate 1 – Sewer System Evaluation shows the sewer system layout and the PSA's delineation of sewer subsystem boundaries, as well as the locations of the industrial activities of interest

related to OU1, the location of sewer lines and the direction of wastewater flow in the sewer system. Other pertinent information on Plate 1 includes the location of manholes and other sewer system components, pipe sizes and materials of construction.

As shown on Plate 1, there are five primary PSA subsystems servicing the area of interest, including subsystems 1A, 5A, 5B, 5C and 6A. The OU1 boundary developed by USEPA (as presented in multiple Agency documents, including the September 2006 Record of Decision), lies wholly within subsystems 1A and 5C. Pipes within the PSA system are constructed of three materials, including clay (terra cotta and vitrified clay), asbestos cement, and cast iron. Pipes of unknown construction material are also present but are likely constructed of these three materials as these are the most common construction materials for municipal sewer systems. Detailed system construction information is presented in the WSW report and is summarized on Table 3 "Summary of Pennsauken Sewer System Network Data for Subsystems in the Vicinity of OU1", including the length of piping and percentage of clay pipe in each sewer subsystem (the remaining pipe being asbestos cement or coast iron). WSW documented that 70% of all sewer lines in and near OU1 are constructed of clay, with the sewer lines of the two subsystems in which OU1 is located, 1A and 5C, comprised of 43% and 96% clay pipes, respectively. Table 3 summarizes the findings from the WSW inspection of manholes and sewer lines in the PSA sewer system.

In its 1983 report, Remington further confirmed that the PSA system was comprised of a high percentage of terra cotta pipes and documented concerns regarding the integrity of aged sewer lines, noting that "joint failures are commonly found in older systems where systems were constructed of terra cotta pipe with joints made of oakum and jute" (at page 8). The 1983 Remington report noted that "the age of Pennsauken's sewer system and the degree to which the town has been developed, combined with the high percentage of terra cotta pipe suggests that the sanitary sewer collecting system may be in an advanced state of deterioration" (at page 9).

In 1982, Remington documented the results of the physical inspection of the sewer system, which included a closed circuit TV survey of selected pipe sections and an inspection of manholes. The Remington report indicated that structural defects were observed in almost every pipe run that was inspected and that all the inspected pipe runs were clay pipes. The inspection report also identified a number of clay pipe sections in which "most joints offset ¼ to ½ inch." Further, the WSW report indicated that physical defects were observed in 22 of the 47 manholes inspected within the area of interest. The documented structural defects of the manholes and the off-set joints by two independent consultants confirms that the PSA sewer lines created multiple pathways for the release of wastewater from the sewer system to the surrounding soils and ground water.

INSERT TABLE 3 HERE

In 1994, the PSA retained Richard A. Alaimo Associates, Consulting Engineers (Alaimo) to conduct a television survey of the sewer system. Alaimo's findings further documented the extensive damage to the sewer system initially evident through the studies conducted in the 1980s. Alaimo's television inspection reports indicate numerous cracks (some to the degree that Alaimo indicated that the line almost appeared to be collapsed), possible cracks, pipe offsets and root intrusions in each visually inspected line. The extensive nature of this damage demonstrates a prolonged period during which the PSA system was not intact, but rather would have enabled wastewater to leak out of the system to the surrounding soils.

The NJDEP also expressed concerns regarding the condition of the sewer lines on several occasions (see February 10, 1983 internal memorandum from Joe Douglas to Dick Dalton of the Division of Water Resources; September 29, 1987 memorandum to the Puchack Well Field SI Review File prepared by Donna L. Gaffigan of NJDEP Bureau of Planning and Assessment; and February 28, 1990 memo discussing an evaluation of water quality at the Puchack, Morris and Delair Well Fields). In the February 10, 1983 memo, Joe Douglas indicated that "[o]ne other possible source of the contamination is the sewage collection system of the Pennsauken Sewerage Authority (PSA). PSA's industrial waste officer told me that, before there was an industrial pretreatment ordinance, one company discharged wastewater to the collection system containing over 70 mg/l chromium. … The portion of the collection system closest to the Puchack Well Field was replaced five years ago because of cracking and infiltration problems due to its age."

In the September 29, 1987 memo, Ms. Gaffigan indicated that an asbestos cement pipe running north of the Puchack Well Field conveyed industrial wastewater from several industrial operations mentioned herein. According to the memo, during a discussion with Ms. Gaffigan, Mr. Ziegmond Karpa, of the NJDEP Division of Water Resources, Southern Enforcement Region, noted that "- - - another potential source may be a 30-inch, gravity fed sewer line that exists approximately 100 feet north of the well field. Leakage from this sewer line may be responsible, at least in part, for the chromium contamination."

This concern is echoed in the February 28, 1990 memo, in which the NJDEP reiterated a conclusion reached by CDM, Inc. in a 1985 report (prepared for USEPA) that the "cone of depression around Puchack Well Field is significant enough so that it could capture soluble contaminants introduced at the ground water table at...the high leakage rate area of the Pennsauken Sewage Authority's sewer system." As such, the NJDEP recommended additional investigations of PSA sewer system leakage as a possible source of ground water contamination.

The above information clearly demonstrates that the PSA system had experienced losses in integrity throughout its system such that associated wastewater releases to underlying soils and ground water likely occurred over time. The probable contribution to the hexavalent chromium in OU1 from these sewer line leaks and industrial dischargers to the PSA system is discussed below.

c. Correlation between Infiltration and Exfiltration in Sewers

The USEPA in 1989 conducted studies to establish the correlation between infiltration and exfiltration rates in sewer systems. The findings are presented in a USEPA report entitled "Results of the Evaluation of Ground Water Impacts of Sewer Exfiltration, February 1989." Those infiltration/exfiltration studies were performed in selected sewer system sections of clay or concrete pipes which were at least 20 years old--conditions similar to those found in the PSA sewer system. Laboratory and field measurements were conducted by USEPA to estimate the rates of infiltration and exfiltration. The results of these studies indicated that those sewer systems with high infiltration rates (where sewer pipes are typically located below the ground water table) are also prone to high exfiltration rates in those portions of those systems where the sewer pipes are located above the ground water table. The study results also showed that for the sections tested, the rate of exfiltration from the sewer system exceeded the rate of infiltration into the system. The ratio of exfiltration to infiltration ranged from 1.5 to 14.2. These findings are particularly relevant for the sewer system in the vicinity of Puchack Well Field where there are documented high rates of infiltration and where the majority of pipelines are *above* the water table.

Both the PSA and the CCMUA employed independent consulting firms to conduct infiltration and inflow analyses of the PSA's sewer system. The 1983 Remington report confirmed locations of sewer line segments in which infiltration was observed and the rate of the observed infiltration for the specific sewer subsystem components within the area of interest (see Plate 2). As shown on Plate 2, significant infiltration, in some instances exceeding 10 gallons per day per foot (gpdf), was documented in both terra cotta and asbestos cement lines within subsystems 1A, 5A, 5C and 6A, particularly along and near Derousse and Sherman Avenues, as well as in subsystem 5B along Suckle Highway. Based on the studies completed by USEPA in 1989, even higher rates of exfiltration could be expected in these sections of the PSA sewer system.

The WSW report further confirmed that 76% of all sewer pipes are located above the ground water table and that 70% of the sewer system located in and around the Puchack Well Field and OU1 is comprised of clay pipe. The previously documented structural failure of the clay pipes within the PSA system indicates that the system was not intact. Therefore, consistent with the findings of the USEPA's study, elevated rates

of exfiltration are also expected in these portions of the PSA system, likely above the rates of infiltration identified by Remington. Notably, the capture zone analysis also confirmed that these leaky sewer lines were located with the capture zone of the Puchack Well Field during the relevant time period, as indicated on Figure 27.

d. Conveyance of Known Chromium Contaminated Discharges through the Sewer System

In light of the documented integrity issues experienced by the PSA system, including high rates of exfiltration, ENVIRON evaluated available data to determine the quality of wastewater historically conveyed in the PSA system and identified industrial entities that released chromium to the system. Of particular note in this regard, the CCMUA gathered information as part of its 1979 evaluation of industrial discharges to the CCMUA system, which encompassed wastewater discharges to the PSA system (then designated as District II of the CCMUA system) (hereinafter, the "1979 CCMUA Report"). The 1979 CCMUA Report included analyses of wastewater collected from 106 industries and of influent wastewater and sludge from POTWs. Analyses specifically targeted heavy metals, including chromium, as constituents of particular concern. The CCMUA study reported sampling results, as well as average daily wastewater flow from the responsive industries. Plate 1 provides the chromium results for the industries within the area of interest, as well as the mass of chromium released to the PSA system, in pounds per day (CCMUA, 1979).

ENVIRON also identified 12 industrial facilities for which available data indicate that chromium was present in the facility wastewater discharged to the PSA sewer system. The conveyance of industrial wastewater from these facilities is presented in Plate 3.

The CCMUA obtained data from these facilities as part of the CCMUA's September 1979 survey of heavy metal discharges from industrial and other system users. For each facility, the CCMUA study provides the chromium concentration in mg/l and the metal loading in pounds/day. In addition, for certain facilities the PSA also obtained wastewater monitoring data in the mid 1980s. These facilities are listed below with summarized chromium wastewater data, as well as any currently available additional information regarding facility operations.

Although specific information regarding the wastewater discharges from each facility is provided individually below, given that eight of the 12 industries discharge to a single trunk line, information regarding that trunk line is present in this introductory section. As shown on Plate 3, industrial wastewater from the following industries ultimately discharge via gravity sewer main and/or force mains to an approximately one-mile long 24-inch and 27-inch asbestos cement pipe trunk sewer line that flows less than 300 feet north of the Puchack Well Field: Donut Management; Elco; GSM;

Natico; Penler; RMP; Superior Varnish; and US&W. This is the only trunk sewer located in close proximity to the Puchack Well Field and therefore, likely is the sewer line mentioned in the September 29, 1987 memorandum by Donna L. Gaffigan of NJDEP which states, relative to the Department's assessment of possible contributors to the Puchack Well Field contamination "- - - another potential source may be a 30-inch, gravity fed sewer line that exists approximately 100 feet north of the well field. - - - Leakage from this sewer line may be responsible, at least in part, for the chromium contamination."

i. Aluminum Shapes, L.L.C.

Aluminum Shapes discharged chromium-containing wastewaters to the PSA sewer system. These discharges initially were to an 8-inch terra cotta line running south-southwest along River Road to a 12-inch terra cotta line leading to the Delair Pumping Station. As discussed below, wastewater from the Building 3 & 4 vault (from 1964-1980) was discharged to the PSA sewer system without any pretreatment. Subsequently, wastewater discharges from the Building 3 & 4 vault (from 1980-1982) and the Building 7S vault (from 1982-March 2002) were treated at an on-site wastewater treatment plant prior to being discharged to the PSA sewer system. This pretreatment included the settlement of solids, which were pumped to a filter press for dewatering before being drummed for off-site disposal. Wastewaters from the flocculation and dewatering steps were discharged to the PSA sewer system. The available historical data along with data of the facility's wastewater after pretreatment demonstrates that Aluminum Shapes consistently discharged chromium to the PSA system at elevated concentrations.

According to the CCMUA's study of 1979, wastewater flow measured by CCMUA at Aluminum Shapes was 282,000 gallons per day. Historical analytical data for Aluminum Shapes' wastewater demonstrates that it contained chromium concentrations as high as 6.5 mg/l in 1979—a period of time when Aluminum Shapes did not pretreat its wastewater. The excessive chromium concentrations in Aluminum Shapes' wastewater were also reported in the PSA Commission meeting minutes from August 2, 1977. That meeting had been called specifically to obtain an injunction against Aluminum Shapes for violating the PSA's Industrial Waste Ordinance. During that meeting, the Township Engineer's Office noted that Aluminum Shapes discharged high concentrations of chromium.

Analytical data of Aluminum Shapes' wastewater obtained throughout the 1980s demonstrates the facility's continued trend of having excessive chromium levels in its wastewater, even after pretreatment was implemented at the facility. PSA Certificates of Analysis documented the following elevated total chromium

concentrations in wastewater from the Aluminum Shapes' facility between 1983 and 1986.

Date	Hexavalent Chromium Concentration	Total Chromium Concentration
April 1983	<0.10 mg/l	12.0 mg/L
July 1983	0.15 mg/L	
January 1984	0.11 mg/L	
April 1984	<0.10 mg/l	3.2 mg/L
April 1984	1.5 mg/L	4.45 mg/L
May 1984	1.5 mg/L	5.75 mg/L
June 1986	<0.10 mg/l	1.29 mg/L

Although lacking data for the year 1985, a February 25, 1985 letter from the PSA to the NJDEP indicated "on February 12, 1985, Aluminum Shapes was caught illegally discharging a blue colored effluent high in settleable solids and believed to be high in chromium."

Aluminum Shapes was issued its New Jersey Pollutant Discharge Elimination System (NJPDES) permit (No. NJ0034576) effective November 1, 1986 through October 31, 1991. Aluminum Shapes' pattern of discharging wastewater with excessive chromium concentrations was the subject of numerous NJDEP Compliance Evaluation Inspections that gave Aluminum Shapes an "unacceptable" rating for violations of its NJPDES permit.

Aluminum Shapes' continued exceedance of its NJPDES permit limitation for chromium resulted in the NJDEP issuing the facility an Administrative Order and Notice of Civil Administrative Penalty Assessment (AO/NOCAPA) on April 27, 1990. The AO/NOCAPA detailed the facility's violations of its NJPDES permit for chromium discharge limitations occurring between December 1, 1986 and December 31, 1989:

- Chromium (total) was reported at outfall DSN001 exceeding the daily maximum of 0.543 mg/l during nine of the quarterly monitoring periods between December 1, 1986 and December 31, 1989. The highest concentration reported was 2.37 mg/l during the April-June 1989 monitoring period.

- Chromium (total) was reported at outfall DSN001 exceeding the monthly average discharge limit of 0.223 mg/l during six of the quarterly monitoring

periods between December 1, 1986 and December 31, 1989. The highest concentration reported was 0.616 mg/l during the August-October 1987 monitoring period.

- Chromium (total) was reported at outfall DSN S01 exceeding the discharge limit of 0.1 mg/l during two of the quarterly monitoring periods between December 1, 1986 and December 31, 1989. The highest concentration reported was 2.12 mg/l during the July-October 1987 monitoring period.

The historical analytical data coupled with the extensive data from Aluminum Shapes' operations after pretreatment demonstrate that Aluminum Shapes had a prolonged history of discharging high concentrations of chromium in its wastewater to the leaking PSA sewer system.

ii. C.J. Osborn Chemicals, Inc./Cook Composite

The C.J. Osborn Chemicals, Inc./Cook Composite facility is located at 920 Sherman Avenue in Pennsauken. Data provided by the CCMUA indicates that the facility discharged wastewater having a chromium concentration of 110 µg/l, resulting in a chromium loading to the PSA sewer system of 0.20 pounds/day. Wastewater flow measured at that time by the CCMUA indicated a daily flow of 227,000 gallons. The PSA also analyzed wastewater effluent samples from this facility between March 1983 and August 1984. Based on those data, the facility discharged wastewater to the PSA sewer system with a maximum chromium concentration 90 µg/l. The C.J. Osborn Chemicals, Inc./Cook Composite facility discharges wastewater to a 10-inch terra-cotta sewer line approximately 2,000 feet southeast of the Puchack Well Field.

iii. DeSoto, Inc.

The DeSoto, Inc. facility is located at 8600 River Road in Pennsauken. Data provided by the CCMUA indicates that the DeSoto, Inc. facility discharged wastewater having a chromium concentration of 70 µg/l, resulting in a chromium loading to the PSA sewer system of 0.01 pounds/day. DeSoto, Inc. discharged wastewater to the same wastewater lines as Aluminum Shapes, discussed above.

iv. Donut Management

The Donut Management facility is located at 1395 Suckle Highway in Pennsauken, approximately 2,300 feet northeast of the Puchack Well Field. Data provided by the CCMUA indicates that the Donut Management facility discharged

wastewater having a maximum chromium concentration of 280 µg/l, and based on an average chromium discharge concentration of 130 µg/l, the CCMUA estimated a chromium loading to the PSA sewer system of 0.005 pounds/day. The Donut Management facility discharges its wastewater to a 15-inch sewer line of unknown material running westward along Suckle Highway to a 15-inch terra-cotta line flowing southeast along Union Avenue before discharge to a 24-inch and 27-inch asbestos cement trunk line leading to the Delair Pumping Station. A portion of this trunk line is less than 300 feet north of the Puchack Well Field. This appears to the same line mentioned in the September 29, 1987 memorandum by Donna L. Gaffigan of NJDEP as a potential source of chromium contamination to the Puchack Well Field, as discussed above.

v. Elco Varicircuits, Inc./Elco Corporation

The Elco Varicircuits, Inc./Elco Corporation facility is located on Commerce Highway in Pennsauken, approximately 1.5 miles east of the Puchack Well Field. However, wastewater generated from this facility was discharged to piping that ultimately discharged to the 27-inch asbestos cement trunk line along Lennox Avenue, immediately north of the Betsy Ross Bridge and less than 300 feet north of the Puchack Well Field. Data provided by the CCMUA indicates that the Elco Varicircuits, Inc. facility discharged wastewater having a chromium concentration of 30 µg/l, resulting in a chromium loading to the PSA sewer system of 0.02 pounds/day. Wastewater flow measured by the CCMUA at that time indicated a daily flow of 100,500 gallons. The PSA also analyzed wastewater effluent samples from this facility between March 1983 and July 1984. Based on these data, the facility discharged wastewater to the PSA sewer system having a maximum chromium concentration 400 µg/l.

vi. Garden States Motors, Inc.

The Garden States Motors facility is located at 1435 Melrose Highway in Pennsauken, approximately 2,000 feet northeast of the Puchack Well Field. Data provided by the CCMUA indicates that the Garden States Motors, Inc. facility discharged wastewater having a chromium concentration of 20 µg/l, resulting in a chromium loading to the PSA sewer system of 0.002 pounds/day. The PSA also analyzed wastewater effluent samples from this facility between March 1983 and August 1984. Based on those data, the facility consistently discharged chromium-bearing wastewater to the PSA sewer system containing a maximum chromium concentration 195 µg/l. Wastewater from this facility was discharged to the same

sewer lines discussed above under Subsection d.iv in this chapter (for "Donut Management").

vii. King Arthur, Inc.

The former King Arthur facility was located at 965 Bethel Avenue, approximately 2,800 feet southwest of Puchack Well # 6. As discussed in detail in Section III.B.4, King Arthur's industrial operations generated chromium plating wastewater. Although the buildings at the King Arthur site were reportedly always connected to the municipal sewer system, according to the PSA meeting minutes dated July 8, 1980, King Arthur also reportedly discharged wastewater "overflows" onto the ground, which ultimately discharged to the sewer system[3]. The overflow substance was noted by the PSA to be "some kind of acid" (likely including chromic acid), which the PSA indicated in the referenced meeting minutes was of concern because it could be detrimental to the sewer system. The sewer line which directly serviced the facility was an 8-inch asbestos cement line, which the PSA determined to have an elevated infiltration/inflow rate of 1.75 gpd/ft. This line flowed into a 27-inch asbestos cement trunk line along River Road and to the PSA Sewerage Treatment Plant.

viii. Natico, Inc.

The Natico, Inc. facility is located at 1600 National Highway in Pennsauken. Natico began industrial operations at the site in approximately 1954. Starting in 1954, Natico manufactured fiber drums at the facility. From 1976 until 1989, Natico also manufactured steel drums. These operations included manufacture of liners and lids, mixing and heating of plastics, pigment mixing, spray painting of the finished drums and silk-screen printing. From 1981 until 1989, Natico's operations additionally included the manufacture of polyethylene drum lids. As of May 1990, Natico was still manufacturing 55-gallon fiber drums with polyethylene liners. The welding machinery used for steel drum production was cooled with non-contact cooling water, which was discharged to the PSA system under a permit.

Available wastewater analytical results for Natico's discharges to the PSA-sewer system document chromium concentrations present in the wastewater over time. For example, the 1979 CCMUA Report documents wastewater having

[3] Available information suggests that the King Arthur site was connected to the PSA sewer system in or prior to 1978. Nonetheless, documentation also indicates that the industrial process wastewater, as well as sludges, were discharged to the ground.

chromium concentrations of 0.02 to 0.19 mg/l between April and August 1979. Wastewater flow measured by the CCMUA at that time indicated a daily flow of 30,000 gallons. Subsequent maximum chromium concentrations include a hexavalent chromium concentration of 0.11 mg/l detected in April 1984 and a total chromium concentration of 0.25 mg/l detected in May 1983. Natico released wastewater to a 12-inch pipe of unknown material; the PSA determined that this line had an elevated infiltration/inflow rate of 6.51 gpd/ft. This line connected to the lines discussed above related to Donut Management and Garden States Motors.

ix. Penler Anodizing, Inc.

The former Penler Anodizing, Inc. (Penler) facility is located at 1400 Suckle Highway, approximately 2,800 feet northeast of the Puchack Well Field. The facility discharged its wastewater to the 12-inch pipe immediately downstream of Natico, as discussed above, likely to the section of that line with the documented infiltration/inflow issues. Wastewater flow then continued into the 15-inch, 24-inch and 27-inch lines discussed under subsection d.iv. in this chapter for "Donut Management."

Available wastewater data demonstrate that hexavalent chromium was consistently present in the facility wastewater at elevated concentrations, even after pretreatment procedures were implemented. The earliest such data collected by Penler are from June and August 1984 prior to the facility establishing wastewater pretreatment. These data reveal hexavalent chromium concentrations in wastewater of 1.2 mg/l and 6.8 mg/l. Analysis of a sample that the NJDEP collected from the sanitary sewer at the Penler site on October 20, 1985 revealed a hexavalent chromium concentration of 3.273 mg/l. There is no documentation for this facility to negate the inference that comparable hexavalent chromium concentrations would have been present in wastewater generated at the site prior to 1984.

Under pressure from the PSA to establish wastewater pretreatment[4], Penler installed the chromium conversion unit in August 1987. However, despite operation of that system, hexavalent chromium continued to be detected at elevated concentrations in facility wastewater into 1990, with a relatively consistent presence of hexavalent chromium documented at levels frequently exceeding 1.0 mg/l, to a maximum concentration of 9.0 mg/l. The PSA issued a December 31, 1990 termination notice to Penler given its failure to meet its discharge permit limit of 1.0 mg/l for hexavalent chromium, as well as for exceedances related to other

[4] For example, in a letter dated February 25, 1985 to the NJDEP, the PSA noted that its industrial waste pretreatment program was making progress and identified Penler Anodizing as one of "three companies in which our office must initiate pretreatment."

constituents. There is no information available indicating that Penler brought its wastewater discharges into compliance prior to its cessation of operations in 1991.

x. Reconditioned Motor Parts, Inc. (RMP)

The RMP property is located to the immediate southeast of the corner of Haddonfield Road and Burrough-Dover Lane. A building was constructed on the property in approximately 1959-1960 and RMP established an operation for the remanufacturing of used automotive parts and engines. Process wastewater composed of spent caustic washings from the automotive parts degreasing operation was initially discharged into a series of three adjacent lagoons located in the southeast corner of the property. These lagoons were abandoned by disconnection of piping and placement of fill sometime between 1966 and 1971. Cessation of the lagoons allegedly corresponds to the time of construction of a nearby sanitary sewer line and tie-in from the RMP site in the early 1970s. RMP's wastewater discharge to the PSA system was approximately 25,000 to 29,000 gallons/day. RMP reportedly ceased discharging industrial wastewater to the sewer system in January 1987.

Data provided by the CCMUA indicates that the RMP facility discharged wastewater having a chromium concentration of 3,800 µg/l, resulting in a chromium loading to the PSA sewer system of 0.92 pounds/day. The PSA also analyzed wastewater effluent samples from this facility between March 1983 and March 1985. Based on these data, RMP discharged wastewater having a maximum chromium concentration 320 µg/l to the PSA sewer system. Wastewater from the RMP was discharged to piping that lead, via the Morton Pumping Station, to the 27-inch asbestos cement trunk line immediately north of the Puchack Well Field and the Betsy Ross Bridge.

xi. Superior Varnish Co.

The Superior Varnish facility is located at the intersection of North Crescent Boulevard and Clements Avenue. Data provided by the CCMUA indicates that Superior Varnish Co. discharged wastewater having a chromium concentration of 0.1 mg/l, resulting in a chromium loading to the PSA sewer system of 0.09 pounds/day. Wastewater flow measured by the CCMUA at that time indicated a daily flow of 118,000 gallons. Wastewater from this facility was discharged to an 8-inch terra cotta line running southeast along Bethel Avenue, joining lines servicing a predominantly residential area to the east before discharging to 16-inch asbestos cement line located along N. Crescent Boulevard, and ultimately, to the

24-inch and 27-inch trunk line directly north of the Puchack Well Field, as discussed above for other facilities.

xii. United Steel and Wire, Inc.

The former US&W facility is located at 1650 Suckle Highway in Pennsauken, approximately 3,700 feet northeast of the Puchack Well Field. The US&W site was apparently developed for industrial use in or about 1956, and was initially operated by Suckle Electronics from approximately 1956 until 1976 for the production of electrical parts for the power distribution industry. The site was then briefly operated by General Home Products from 1976 to 1979 for the production and storage of household product, including washing machines and dryers. Roblin Industries produced metal shopping carts at the property from 1979 until 1982, when US&W acquired the site. Roblin reportedly installed a wastewater treatment plant on-site in 1981. US&W continued shopping cart manufacturing activities until it ceased operations in 1989. Since that time, US&W has leased the property to Tru-Fit Doors.

Information regarding US&W's industrial operations, submitted by US&W to the USEPA, as well as on behalf of US&W to the NJDEP, indicates that US&W conducted chrome and nickel plating as part of its manufacturing activities. The chrome plating operations included use of a chrome solution plating tank, a chrome rinse tank and tanks for storage of chromium-contaminated wastewater. Soils near the loading dock where the wastewater sludge were stored were found to have a maximum chromium concentration of 594 mg/kg, with ground water at that location containing chromium up to 1,160 µg/l. Soil remediation was later conducted to address chromium contamination at the loading dock area.

Wastewater was discharged from this facility to an 8-inch line (of unknown construction), directly upstream of Natico, Inc. As such, wastewater from US&W commingled with wastewater from four other facilities in that industrial park prior to discharge to a 15-inch terra-cotta line along Union Avenue and ultimately to the 24-inch and 27-inch asbestos cement line directly north of the Puchack Well Field.

Data collected by US&W and the PSA confirmed that US&W released chromium to the PSA sewer system. NJDEP records indicate that US&W released as much as 23,500 gallons per day of industrial wastewater to the PSA sewer system. Analyses of wastewater generated at the site were apparently conducted by US&W on a monthly basis, with such monthly data currently available for two periods of time after the pretreatment system had been installed, including April 1983 through August 1984, and January 1987 through March 1988. These analyses indicate maximum total and hexavalent chromium concentrations of 26,200 µg/l

and 5,800 µg/l, respectively. US&W informed the PSA that exceedances of its hexavalent chromium discharge permit limitation in April-June 1984 (when the maximum hexavalent chromium concentration of 5,800 µg/l was reported) resulted from a leak in the chromium recovery unit, enabling untreated wastewater to directly enter the PSA system. This indicates that prior to the reported installation of the pretreatment system in 1981, untreated wastewater released to the PSA sewer system contained significantly elevated hexavalent chromium levels. Further, given that the maximum total chromium concentration of 26,200 µg/l was reported in the January 1987-March 1988 monitoring timeframe, when no pretreatment system malfunctions were reported by US&W, those data suggest that releases of comparable total chromium concentrations in wastewater may have been relatively routine. This information indicates that US&W released substantial amounts of total and hexavalent chromium to the PSA sewer system, both prior to and following installation of a wastewater pretreatment system

e. Sludge Disposal from PSA Sewage Treatment Plant at River Road

The PSA Sewage Treatment Plant, formerly located on River Road, started operation in 1955. Based on information available from the minutes of the PSA meetings, the treated wastewater from the Sewage Treatment Plant was discharged to the Delaware River through an outfall and the sludge generated from the treatment processes was discharged to drying beds near the treatment plant premises. Historic aerial photographs of the vicinity available from NJDEP indicate that several greenhouse-type glass enclosures were located on a parcel adjacent to the actual sewage treatment plant. Review of historical practices for treatment and disposal of sludge generated from sewage treatment plants indicate that glass enclosures similar to greenhouses were a common feature used in sludge drying beds to facilitate year-round operation and to reduce fly and odor nuisances from the sludge drying operations. (Metcalf & Eddy, 1930, 1972, USEPA Design Manual, 1982, 1987).

Typically, sludge drying beds involve a filter bed comprising a fine sand layer approximately 6 to 12 inches thick underlain by a coarse sand/gravel layer of approximately 12 to 18 inches thick. As noted in the USEPA Design Manual, 1982 (page 39) "The operative principles involved in sand drying bed installations are evaporation and percolation. Percolation may be either to the ground water or to the under-drain tiles …" Where an under-drain system is provided for the drying bed, a series of drainage tiles (vitrified clay pipes laid with open joints) run through the coarse sand/gravel bed and the intercepted water is conveyed back to the treatment plant. (Metcalf & Eddy, 1930, 1972, USEPA Design Manual, 1982, 1987). The water that is not intercepted by the drainage tiles percolates to the ground water. The USEPA Design

Manual 1982 (page 39) further notes that "…In some locations, environmental constraints due to leaching of nitrogen compounds and other constituents have resulted in the requirement to seal the bottom of the drying bed with an impermeable liner…".

Ammonia is present in the area of OU1 at concentrations exceeding 2 mg/l. Concentrations of this magnitude are likely indicative of a municipal wastewater source. Figure 29 shows the extent of ammonia contamination in the vicinity of the Puchack Well Field. These ammonia data represent the average of the 1998, 2000, and 2001 sampling rounds. Particle tracking shown in Figure 29 clearly indicates that the source of the ammonia is in the vicinity of the sludge drying beds. Contamination of the ground water by ammonia would also indicate contamination of ground water by infiltration of chromium, which was present in the sludge waste. As noted above, the wastewater discharged to the PSA sewer system included industrial discharges from several industries, including those that contained high concentrations of chromium. Chromium concentrations in the influent to the PSA Sewage Treatment Plant ranged from 0.16 to 2.7 mg/l (average 0.71 mg/l), with chromium concentrations in the sludge discharged from the plant ranging from 88 – 6,920 mg/kg (average 4,612 mg/kg) (CCMUA, 1979).

PSA records document that from July 1972, if not earlier, until at least 1979, wastewater treatment plant sludge was disposed by the PSA at the Pennsauken Landfill, a former sand and gravel quarry that was used for unpermitted waste disposal, including below the water table, beginning in the 1960s (see Section III.B.2 below).

f. Summary of Sewer System Evaluation

ENVIRON's assessment of the PSA sewer system indicates that the majority of the sewer lines within and around the Puchack Well Field and OU1 (i.e., PSA subsystems 1A, 5A, 5B, 5C and 6A) are constructed of clay and are located above the water table. Further, certain of these lines have significant rates of infiltration/inflow and are proximate to the Puchack Well Field and OU1. Given the documented presence of no less than 12 industrial entities that released chromium-bearing wastewater to the PSA sewer system, chromium was released from the PSA system to the underlying ground water.

Piping within the PSA sewer system has been shown, through visual inspections, television logging and two infiltration/inflow studies, to have suffered significant loss of integrity over time. This is not unexpected given the typical methods of construction for older sewer lines, often entailing construction with clay as is the case with the majority of the PSA sewer system. In light of the age of the terra cotta piping, much of which in OU1 is likely more than 50 years old, and the construction methods for pipes of that vintage, wastewater leakage is likely throughout the terra cotta piping system,

even in pipes that have not yet been inspected and documented as being of suspect integrity. Infiltration/inflow studies have also documented significant infiltration and inflow in sewer lines constructed of asbestos cement and unspecified materials, demonstrating that sewer system integrity losses are not confined to clay piping only.

Furthermore, discharges to ground water from the PSA's sludge drying beds were captured by the Puchack Well Field throughout the period of operation of the PSA Sewage Treatment Plant. As noted above, evidence of this discharge to ground water can be seen in the concentrations of ammonia in the vicinity of the PSA Sewage Treatment Plant.

Therefore, discharges of chromium wastes to the PSA sewer system had two pathways by which chromium contamination would contribute to OU1. First, compromised sewer lines carrying chromium waste from industrial discharges would have allowed discharge of chromium waste to ground water and subsequent capture by the Puchack Well Field. Second, sludge disposal practices of the PSA allowed for discharge to ground water of wastes containing chromium from the sludge drying process, which discharge was also captured by the Well Field.

2. Pennsauken Sanitary Landfill

There is material credible evidence that the Pennsauken Landfill contributed the chromium ground water contamination of OU1. The USEPA and USGS determined not to name the Pennsauken Landfill as a PRP because of the impressions they received from the USGS' limited ground water model for the Puchack Well Field. As previously discussed, those data were incomplete and ignored the relevant time period for any scientifically sound PRP evaluation. In light of the new data showing that groundwater from the Pennsauken Landfill did indeed impact the Puchack Well Field during the relevant time period, that site needs to be re-evaluated as a PRP and the idea that there is a completely separate chromium groundwater plume at the Landfill needs to be reconsidered.

Over the many decades that the Pennsauken Landfill has been in operation, it has been a continuing source of environmental contamination in Pennsauken. There is currently ongoing litigation in which the source of the chromium groundwater contamination at question at and around the Landfill, as well as the issue of Landfill operators' negligence are being litigated. Investigations by SL and ENVIRON have only scratched the surface of the vast amount of data, documents and sworn deposition testimony concerning the Landfill that is relevant to its role as a PRP for the chromium contamination at issue in OU1. Nevertheless, there are certain well-known facts concerning the Landfill that are not disputed, including the fact that from the first time groundwater at the Landfill was tested for chromium in the early 1980s, elevated levels of that substance were routinely detected.

Since there was no earlier testing data for chromium at the Landfill, there is no way to tell how early the groundwater in the impacted areas was contaminated.

Another undisputed fact about the Landfill is that there was chromium contaminated soils and chromium containing leachate detected at various locations at the landfill. A third undisputed fact is that the NJDEP ordered the Landfill to remedy the chromium contaminated ground water approximately 20 years ago and no such remediation has yet taken place. Similarly, the Landfill took over 20 years to properly cap the unlined cell even though it was required to do so many years earlier.

The Pollution Control Financing Authority of Camden County ("PCFA") currently owns and operates the Pennsauken Landfill, a municipal solid waste disposal facility located at 9600 River Road in Pennsauken, approximately 4,000 feet northeast of the Puchack Well Field. The Landfill property was formerly owned by Ward Sand and Materials Company ("Ward") and used for sand and gravel mining operations, which reportedly began in the 1940s and continued until 1978 when the Township purchased the site. In addition to the aggregate mining operations, Ward also operated an unlined landfill, identified as NJDEP Facility 0427A ("Facility 0427A").

Facility 0427A covers an approximate 40-acre area located in the southwestern portion of the Landfill, just east of the adjacent Aluminum Shapes property. Waste disposal at the Facility 0427A location reportedly began under Ward's ownership in or about 1962 to 1965. Specifically, JCA determined that in 1962, there appeared to be evidence of drums being disposed at Facility 0427A and also opined that in 1965. Waste disposal continued through 1978 under Ward's ownership, and was continued from 1978 through 1982 by the Township. Initially, waste disposal was conducted on an informal (unregulated) basis at Facility 0427A until Ward received authorization from the Township via Certificate of Registration dated August 11, 1970. Note that from 1965 to at least 1975, Ward reportedly extended their aggregate sand and mining operations *below the water table* in the south central portion of the site (including the eastern portion of Facility 0427A).[5] James C. Anderson Associates, Inc. (JCA), consultant to the Landfill, concluded that wastes disposed of in Facility 0427A from at least 1965 until approximately 1975 were emplaced directly into ground water.

In addition to emplacement within ground water at Facility 0427A, Ward also reportedly conducted disposal in areas outside of the permitted boundaries, in an area now known as the North Fill Area ("NFA"). Past remedial reports prepared by JCA (1988 Ground water Investigation Report) and Arcadis (2005 Remedial Action Workplan) indicated that this unpermitted disposal occurred during Ward's ownership based on review of historical aerial photographs. It was estimated that at least 120,000 cubic yards of

[5] Records of PSA meetings indicate that the PSA disposed of wastewater treatment plant sludge at the Landfill from July 1972 (if not earlier) until at least 1979.

material was disposed in the NFA, with most of the material being disposed directly into ground water in the area of the former recreational lake. Failure to properly operate the Landfill facility in accordance with its permit is further indicated in a May 1978 letter from the NJDEP Solid Waste Administration to the Camden County Solid Waste Advisory. The letter mentions that operations at the Landfill exhibit a "continued disregard of [the NJDEP's] permitting and design requirements." Landfilling practices during Ward's ownership of the site were not in compliance with State or Township guidelines. During that time period, the Township of Pennsauken and other municipalities and generators disposed of waste at the Landfill.

The Township of Pennsauken received approval to construct a new disposal cell in 1980 and initiated disposal at that facility in 1982. The new cell, Facility 0427D, is located adjacent to and partially overlapping the eastern side of Facility 0427A, at which the Township ceased disposal in June 1982. This NJDEP-registered 28-acre cell was constructed with a clay liner and leachate collection system. While transitioning from Facility 0427A to Facility 0427D, the Township covered Facility 0427A with material that does not meet current landfill cap permeability standards, enabling infiltration into the landfill material. Despite repeated demands by the NJDEP to install a proper cap, it was not until 2004 that an engineered cap was placed over Facility 0427A.

a. Remedial Investigation of Ground Water

Four shallow monitoring wells (MW-1 through MW-4) were reportedly installed in the Upper Aquifer of the PRM at the Landfill in October 1979. Note that Arcadis' report identifies these wells as being installed in the "Upper Aquifer" of the PRM. However, it is likely that reference was intended to mean the Middle Aquifer as elsewhere in Arcadis' report, they note that the Upper Aquifer was largely dewatered beneath the Landfill with the water table residing in the Middle Aquifer (Arcadis, 2005). Four additional monitoring wells (MW-5 through MW-8) were installed in 1981 and 1982 within the Middle Aquifer (MW-5, MW-6, and MW-7) and within the Lower Aquifer (MW-8). According to the PCFA, analysis of ground water samples from these wells was conducted in accordance with a permit issued by the NJDEP on April 22, 1981 pursuant to the NJDEP Bureau of Solid Waste Management (BSWM) rules at N.J.A.C. 7:26-1 et seq. The PCFA further indicated that such monitoring, for the constituents listed in Section 2.5.22 of the BSWM rules, was conducted from 1981 until a NJPDES Discharge to Ground Water permit was issued by the NJDEP in February 1985, under which some monitoring continues to the present. Information is not yet available to confirm when ground water monitoring for chromium was initially conducted at the Landfill. Nonetheless, ground water samples were analyzed for

chromium in the early 1980s, prior to issuance of the NJPDES permit that required chromium analyses as part of ground water monitoring completed at the Landfill.

Ground monitoring data in 1982 from MW-1 through MW-8 revealed chromium concentrations in MW-3 (100 µg/l) and MW-4 (160 µg/l) above the GWQS. In 1983, chromium was detected at MW-6 (1,200 µg/l) above the GWQS. MW-3 is located along the southern edge of the Landfill and MW-6 is located along the southwestern corner of the Landfill property. MW-4 is located off-site along River Road, southwest of the Aluminum Shapes facility discussed above. Sampling conducted pursuant to the NJPDES permit identified hexavalent chromium in ground water at two wells in February 1986, including MW4 (980 µg/l) and MW6 (260 µg/l).

It was determined that additional monitoring wells were required because the initial monitoring network did not adequately assess the nature of background ground water quality. Accordingly, between 1986 and 1988, JCA installed additional wells in two phases of investigation. In the first phase, completed in 1986 and 1987, nine additional wells were installed in the uppermost saturated zone, the zone in which contamination had been identified through prior sampling, and because JCA concluded that contamination associated with on-site source areas would most likely appear at the highest concentrations in the most shallow saturated interval. The depths at which ground water was encountered in these wells ranged from 25 to 85 feet such that the wells were likely screened in the Middle Aquifer. The locations of these wells were determined, in part, based on anomalies identified by a geophysical survey of the Landfill that JCA conducted in October 1985, which identified significant anomalies in the Facility 0427A portion of the site, as well as in the southeast corner of the Landfill property.

Ground water samples were collected from 20 wells in July 1986. Analytical results of the sampling program identified elevated concentrations of total and hexavalent chromium in the southwestern portion of the site at MW-4 (total and hexavalent chromium each present at 530 µg/l) and MW-6 (total chromium at 1,500 µ/l and hexavalent chromium at 870 ug/l). Additionally, samples from wells in the northern portion of the Landfill revealed elevated levels of chromium in GWS-13/MW-10 (70 µg/L) and OW-4 (80 µg/L). GWS-13/MW-10 is located along River Road at the western property boundary in the central portion of the Landfill and OW-4 is located east of the North Fill Area near the northeast corner of the Landfill. Data from JCA also reported that chromium was detected in GWS-45 (in the northern half of Facility 0427A) at a concentration of 130 µg/l in July 1988.

JCA determined that ground water flow in the Middle Aquifer and Lower aquifer units was primarily to the southwest (in the general direction of the Puchack Well Field). JCA also indicated that Facility 0427A was constructed without a liner or a

leachate collection system such that "leachate it generates may freely migrate vertically to the water table."

Based on the data it obtained, JCA recommended additional ground water evaluations near MW-6 to more fully characterize potential source areas for the ground water contamination, as well as additional Landfill source material testing for ground water source determinations. These recommendations were implemented in the second phase in 1987 and 1988, which included installation of 21 additional wells installed in the Upper and Middle Aquifers, as well as in the perched water within the waste material above the water table. Elevated chromium concentrations were again detected at MW-4 (total chromium of 920 µg/l in July 1988, and hexavalent chromium between 470 and 1,300 µg/l between April and July 1988) and MW6 (hexavalent chromium of 560 µg/l in April 1988).

Hexavalent chromium was detected in several wells during rounds of NJPDES monitoring in 1992, with MW-2, MW-3, MW-3D, MW-4, MW-5, MW-8, MW-10, MW-11, MW-11D, MW-12, MW-17, MW19, MW-20, and MW-20D all containing chromium at concentrations exceeding the GWQS of 70 ug/l. Ground water samples collected from MW-3 revealed exceedances of the GWQS for chromium in 1992 and 1993. The maximum total chromium concentration detected was 310 µg/l, while the maximum hexavalent chromium concentration detected was 3,100 µg/l. Analysis of ground water samples from wells installed in the summer of 2003 revealed chromium in DW-2U (132 µg/l), located in the southeast corner of the Landfill near NJPDES monitoring well MW-3.

b. Remedial Investigation of Soils

As part of the study completed by JCA in 1987-1988, 15 test borings were completed and soil samples were collected in areas of geophysical anomalies. Four soil samples were collected from each boring for a range of analyses, including chromium. JCA indicates that "[total] chromium (100 mg/kg) and hexavalent chromium (13.5 and 3.5 mg/kg)…concentrations in [samples from GWS-6] exceed their reported mean values in natural soils." The 2005 Arcadis report summarized the findings of the JCA investigations, noting that chromium was detected in soils ranging from 5.5 mg/kg to 100 mg/kg.

c. Remedial Investigation of Perched Water/Leachate

Additional investigations were conducted by JCA in connection with preparation of the May 1990 Expanded Remedial Investigation Report (Expanded RI Report). Wells P-5, P-6, P-7, and P-8 were installed in 1990 to evaluate the depth of waste material in the Landfill and to characterize leachate. Perched water/leachate was also sampled in

previously existing wells. Chromium was detected in these leachate samples ranging from 0.052 mg/l to 0.13 mg/l. JCA noted that "subsurface investigation of Facility 0427A…detected a zone of highly contaminated water (leachate) within landfilled wastes that is perched and/or mounded above the water table (unconfined aquifer beneath the site)". JCA reported that there were two main areas of perched leachate: one bound by River Rd., GWS-7, GWS-38 and GWS-41, and a second bound by GWS-45, GWS-49, P-5, P-6, P-7, and P-8, the latter area corresponding to a large portion of Facility 0427A. JCA also admitted that leachate formation was enhanced by poor grading of the surface and use of a semi-permeable material to "cap" the Landfill from 1982 through 2004. Since no liner or leachate collection system was installed for Facility 0427A, any leachate produced had an unrestricted pathway to ground water beneath the Landfill.

The USGS and NJDEP determined that leakage was possible between the Upper, Middle and Lower aquifers at and in the vicinity of the Landfill. JCA and Todd Giddings and Associates also reached this conclusion. The JCA report noted that "leakage occurs from the water table unit to the lower unit due to a slight vertically downward gradient that has developed as a result of over-pumpage of the lower, semi-confined unit." Todd Giddings referenced a "considerable vertical leakage". The Todd Giddings report analyzed a "worst-case effect" for the design of a new landfill (likely the 0427D cell based on the timing of the report) and its impact on water supply wells located in Pennsauken Township. The report considered the clay liner and leachate collection system for this proposed Landfill cell, but noted that if the clay liner and the leachate collection system failed, "leachate would enter the aquifers beneath the proposed landfill and migrate downgradient in the ground-water flow system." As Facility 0427A operated for approximately 20 years without a liner or leachate collection system, these conditions would likely apply to the leachate and ground water within the vicinity of Facility 0427A.

An August 1979 letter from the NJDEP to the Township of Pennsauken directed the Township to address violations for leachate "leaving the [L]andfill…and causing surface water contamination." Leachate seeps and movements at the Landfill were common.

JCA noted in its 1990 Expanded RI Report that seeps were observed at various locations throughout the Landfill, including at the base of the berm adjacent to the Aluminum Shapes property. Though the seeps were not flowing at the time of JCA's observations, they were characterized by stains and sheens. The seepage discharge from Facility 0427A was measured at 596 ft^3/day at the time of JCA's field observation.

d. Conclusions

Documented leachate conditions in the area of Facility 0427A indicate that a lack of proper grading, the absence of a liner, a failure to install a leachate collection system and delays of over 20 years before installing an impermeable landfill cap over Facility 0427A have resulted in formation of pockets of leachate. Analysis of this perched water/leachate revealed chromium concentrations ranging from 0.052 mg/l to 0.13 mg/l. Additionally, JCA noted that "leakage occurs from the water table unit to the lower unit due to a slight vertically downward gradient that has developed as a result of over-pumpage of the lower, semi-confined unit." A 1980 investigation by Todd Giddings and Associates also supported the pathway for leakage between the upper and lower aquifers, especially south-southwest (downgradient) of the Landfill.

Soil samples obtained in the vicinity of Facility 0427A contained chromium ranging from 5.5 mg/kg up to 100 mg/kg. The presence of chromium in the soil at these concentrations, in conjunction with the lack of an impermeable landfill cap, would facilitate the migration of chromium to the underlying ground water. Further, available information indicates that chromium-contaminated wastewater treatment sludge from the PSA was one of the waste types disposed of in the unlined Facility 0427A, where wastes were emplaced directly into ground water.

Ground water has been monitored at the Landfill for more than 20 years. The main trends exhibited at the site show high concentrations of chromium in off-site MW-4 and on-site MW-6. Though ground water flow direction may be variable based on pumping rates and other conditions, the overall ground water flow direction is to the south-southwest towards the Puchack Well Field. Moreover, particle tracking and modeling show that the Landfill was within the Puchack Well Field's zone of influence during the relevant time period. Given that ground water from the Landfill can flow southwest and impact MW-6 at the southwestern corner of the Landfill property, and since chromium was detected above the GWQS in various wells around the site, the Landfill is a PRP for the chromium ground water contamination at issue in OU1.

Hexavalent chromium ground water contamination is present near the southern boundary of the Pennsauken Landfill and may relate to historical disposal activities at Facility 0427A. Based on particle tracking and ground water modeling as discussed above in Section II, the ground water contamination originating at the southern half of the Landfill was within the capture zone of the Puchack Well Field during the timeframe that corresponds to when contamination was observed in the Puchack wells. In light of the information summarized above, there is sufficient evidence indicating that the Pennsauken Sanitary Landfill likely contributed to hexavalent chromium ground water contamination at the Puchack Well Field Superfund Site.

3. Aluminum Shapes, L.L.C.

Aluminum Shapes was not named as a PRP for Puchack Well Field OU1 despite its long history of discharging chromium at its Pennsauken site and through the compromised PSA sewer system. It is likely that USEPA had an incomplete and incorrect picture of Aluminum Shapes' role as a PRP because it based its decisions on the data on groundwater flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from Aluminum Shapes, coupled with the evidence of hexavalent chromium discharges at its site and through the leaky sewer system reveals that Aluminum Shapes is a PRP for the contamination at issue in OU1.

a. Site Location and Industrial Operations Overview

The Aluminum Shapes facility is located at 9000 River Road in Delair, New Jersey, approximately 3,800 feet northeast of the Puchack Well Field, as shown on Plate 1. Aluminum Shapes began industrial operations at the site in approximately 1957; the site was reportedly undeveloped prior to Aluminum Shapes's occupancy. Aluminum Shapes operates the facility for aluminum smelting, extruding, and manufacturing. In addition to smelting of aluminum alloys, the facility prepares aluminum products through the processes of extrusion, cutting, painting, and packaging. Structures on-site include the main manufacturing building and a foundry building. The manufacturing building is divided into sections referenced as "Building 1" through "Building 11".

Chromium was used in processes at the site beginning in 1964 when chromic acid was introduced as an etching agent in the painting preparation process. The chromic acid-bearing solution was used as a conversion coating to roughen aluminum surfaces prior to painting. Aluminum parts suspended on a conveyor were sprayed with the chromium-bearing solution while stainless steel reservoirs collected excess chromic acid below the conveyor line. A poured concrete vault below the steel reservoirs collected residual fluids that the paint line generated (via overflows or drips from aluminum parts).

Until 1980, chromium and other fluids collected in this vault were discharged by Aluminum Shapes directly to the PSA sewer system without any on-site pretreatment. After 1980, discharge from the vault allegedly drained to a subsurface tank before being treated at the on-site wastewater treatment plant, and ultimately discharging to the PSA system. As discussed below under "MPC Industries, Inc.", untreated sewage from the Aluminum Shapes property overflowed onto the MPC property.

From 1964 until 1982, the etching process occurred in Buildings 3 and 4 of the manufacturing building. Beginning in 1982, a new paint line was installed in Building 7S of the manufacturing building, and the etching operations in Buildings 3 and 4 were

reportedly transferred to Building 7S. The chromic acid-bearing conversion coating was utilized in the paint line in Building 7S until March 1, 2002, when Aluminum Shapes reportedly switched to a hydrofluoric acid/fluoro-titanic acid solution and discontinued use of the chromium-containing material.

Extensive ground water testing has been conducted at the Aluminum Shapes facility since 1986. As detailed below, this sampling has documented substantial hexavalent and total chromium ground water contamination in the Upper Aquifer, Middle Aquifer and Intermediate Zone of the Potomac Raritan Magothy (PRM) aquifer system. Given the breadth of the analytical data available for this site, and because the assessment of ground water quality at the site was initiated independent of concerns regarding soil conditions, the ground water and soils data are presented separately below.

b. Remedial Investigations of Ground Water

To comply with a NJDEP NJPDES Discharge to Ground Water permit, Aluminum Shapes installed ground water monitoring wells MW-1 through MW-6 in 1986 in the Upper Aquifer (i.e., the uppermost saturated zone, present above the underlying semi-confining units that define the upper boundary of the PRM aquifer system). Hexavalent chromium was first detected in ground water at the site in June 1988 in MW-4 (located on the north side of the foundry building). Filtered ground water samples from MW-4 contained concentrations of total and hexavalent chromium of 184 µg/l and 130 µg/l, respectively. Total chromium was detected in ground water at concentrations from 1.78 mg/l to 6.5 mg/l.

Available documentation reviewed indicates that the NJDEP had substantial concerns regarding ground water quality at Aluminum Shapes, and the impacts its operations had on regional ground water quality. Specifically, in a June 28, 1991 internal memo, the NJDEP characterized potential source areas and conditions at the site while calculating the "capture zone" of the Puchack Well Field. The NJDEP determined that "a reasonable technical basis has been developed to conclude that discharges of chromium that occurred at the Aluminum Shapes site are potentially responsible for pollution of ground water and wells at the Puchack Well Field." The NJDEP further recommended that "the magnitude and extent of ground-water pollution resulting from discharges at the [Aluminum Shapes] site should be thoroughly investigated".

In 1993, Aluminum Shapes entered into a Memorandum of Agreement (MOA) with the NJDEP to conduct a site investigation focused on identifying the source of chromium. Twelve areas were identified as requiring investigation, many related to chromium handling, including the outdoor drum storage area (Area A), the former

chromic acid collection vault (Area B), the chromic acid solution collection tank (Area D), the current chromic acid collection vault (Area E), monitoring well MW-4 (Area H), monitoring well PSA-4 (Area K), and former sanitary sewer lines (Areas G and L).

As reported in the Chromium Remedial Investigation Report prepared by Advanced Environmental Solutions in March 2002 (2002 CRIR), Aluminum Shapes conducted a ground water investigation between October 1999 and January 2002. Ten new wells were installed in the Upper Aquifer in exterior portions of the site (MW-1R, MW-5R, MW-6R, MW-9R, and MW-10 through MW-15). Five new Upper-Aquifer monitoring wells were also installed inside the manufacturing building (MW-16 through MW-20). Ground water samples from these and previous monitoring wells revealed hexavalent chromium concentrations in multiple sampling events above the NJDEP GWQS for total chromium at MW-4, MW-10, MW-13 and MW-18, and on one occasion in MW-16, MW-19 and MW-20, some of which were installed to evaluate any impacts from the former sanitary sewer lines (Areas G and L).

The highest hexavalent chromium detections in each well were as follows:

- MW-4: 165 µg/l in January 2002 (where chromium exceedances had been reported since 1988)
- MW-10: 385 µg/l in May 2000
- MW-13: 467 µg/l in October 2001
- MW-16: 101 µg/l in May 2000
- MW-18: 559 µg/l in October 2001
- MW-19: 116 µg/l in January 2000
- MW-20: 339 µg/l in January 2002

Aluminum Shapes installed 8 additional monitoring wells in the Upper Aquifer and 24 additional monitoring wells in the Middle Aquifer between May 2003 and January 2005. Monitoring well installation and sampling information was documented in the Supplemental Chromium Remedial Investigation Report prepared by Roux Associates, Inc. in July 2005 (2005 SCRIR). The 2005 SCRIR reported on ground water conditions in the vicinity of the current vault in Building 7S. Total chromium was detected in MW-19S ranging from 75.9 µg/l (May 2000) to 782 µg/l (January 2005), exceeding the GWQS in five of seven sampling events. Total chromium was also detected in MW-30S at 104 µg/l (January 2005) and 202 µg/l (February 2004). Hexavalent chromium was detected in MW-19S up to 730 µg/l (January 2005) and in MW-30S at 26 µg/l (January 2005) and 120 µg/l (February 2004).

The 2005 SCRIR identified a ground water divide present in the Upper Aquifer beneath the Aluminum Shapes site, resulting from a clay confining layer located beneath the manufacturing building, which causes ground water to flow in both the

southeast and the west-southwest directions. Reportedly, the Upper Aquifer exists only under the manufacturing building given that the clay layer pinches out east and west of the building. This absence of the clay confining layer beyond the building extents therefore enables vertical migration of chromium contaminated ground water from the Upper Aquifer to the Middle Aquifer below. Notably, the 2005 SCRIR documented that chromium concentrations in the Middle Aquifer were highest in the southwest and southeast corners of the site, two distinct areas that generally correspond to the areas where the clay confining layer pinches out.

The area in the southwest corner is located near MW-21I where chromium was detected at a maximum concentration of 417 µg/l in January 2005. The area in the southeast corner is located near MW-15I, where chromium was detected at a maximum concentration of 670 µg/l in January 2005. Based on these and other data obtained at the site, it appears that chromium released to the Upper Aquifer under the building (via the chromic acid collection vaults) was transported in shallow ground water to the southeast and west-southwest due to the ground water divide, and further, that the absence of the clay confining layer beyond the eastern and western ends of the manufacturing building allows for vertical downward migration of chromium-containing ground water into the Middle Aquifer.

c. Remedial Investigations of Soils

In addition to the ground water investigations performed at the site, Aluminum Shapes also conducted soil sampling between September 1999 and April 2000. Elevated chromium concentrations were detected in soils, with the highest concentrations present in the areas surrounding the former and current chromic acid collection vaults (Areas B and E).

Visible soil staining was observed in subsurface soils around and beneath the initial vault (Area B), where chromic acid was handled from 1964 until 1982. Specifically, the 2002 CRIR notes that "In Area B and Area H (well MW-4), yellow to greenish-colored staining indicative of potential presence of chromium was observed in the subsurface soil in [12 borings]". Analysis of soil samples from Area B revealed total chromium at concentrations ranging from 2.9 mg/kg to 6,320 mg/kg, with the highest concentrations between 4 and 11 feet below floor level, and 0.5 to 7.5 feet below the base of the 3.5-feet deep vault. Hexavalent chromium concentrations ranged from less than 2 mg/kg to 2,570 mg/kg. The highest hexavalent chromium concentrations were also detected between 4 and 11 feet below floor level. The deepest samples collected (28 to 28.5 feet below floor level) revealed maximum total and hexavalent chromium concentrations of 35 mg/kg and 7.6 mg/kg, respectively. Based on the vertical distribution of chromium contamination in Area B, and the shallow depth to ground

water in this area, the initial chromic acid collection vault was a source of chromium ground water contamination.

In the vicinity of the more recent chromic acid collection vault (Area E), soil samples were collected from 4.5 to 5 feet below floor level (i.e., the 6-inch interval below the vault). Total chromium was detected in these samples at concentrations ranging from 2.4 mg/kg to 245 mg/kg, with corresponding hexavalent chromium concentrations to a maximum of 204 mg/kg. During this soil investigation, a sample was also collected from the chromic acid-bearing solution in the vault. Total chromium was detected at a concentration of 64,200 µg/l and hexavalent chromium was detected at 66,600 µg/l in the wash water. The 2005 SCRIR notes that the base and sidewalls of the vault were coated with epoxy in 1990 to act as a sealant. However, given that this chromic acid collection vault was installed in 1982, the available information indicates that from 1982 to 1990, the vault walls were not sealed, potentially enabling the release of chromium to the environment.

An additional area of potential discharge was noted in NJDEP documentation from 1989, though it was not specifically investigated in any of the remedial investigation reports reviewed. An undated NJDEP letter (responding to a January 1989 letter from Aluminum Shapes' consultant, BCM) indicated that a "parts cleaner pit" was a potential source of chromium contamination in ground water. The letter went on to discuss a "chronic nature of the leaks [from the parts cleaner] to the pit" and noted that hexavalent chromium was detected in excess of 3 mg/l in a sample taken from the parts cleaner pit. The structural competence of the pit was questioned based on the reported leaking and the low pH detected in the sample from the pit. No further analytical results were reviewed for this area of potential discharge. However, a July 18, 1989 memo indicated that the NJDEP visited the Aluminum Shapes site and sampled the parts cleaner pit with the intention to classify the wastewater as a hazardous waste. This memo also noted that the working conditions in the parts cleaner area were potentially hazardous, as the "hot chromic acid solution is atomized by the spray booth and a vapor fills the area." No further indication of sampling or environmental investigation was indicated in the documentation reviewed by ENVIRON.

d. Conclusions

Based on the documentation reviewed by ENVIRON, chromium soil and ground water contamination at the Aluminum Shapes site has resulted from an extended history of discharges from Aluminum Shapes' on-site operations. This information establishes that Aluminum Shapes: (1) handled hexavalent chromium-bearing materials on-site for a relatively lengthy period of time of approximately 38 years; (2) handled those materials in a manner that caused releases to the environment, resulting in markedly

elevated hexavalent chromium concentrations in soils and ground water in the Upper and Middle Aquifers below the site; (3) adversely impacted ground water in the regional (Intermediate Zone and Lower) aquifer system below the site; and (4) released hexavalent chromium-bearing wastewater (treated and untreated) to the PSA sewer system over a 38-year timeframe. The latest modeling results completed by ENVIRON also revealed that chromium discharges from Aluminum Shapes were within the capture zone of the Puchack Well Field during the relevant time period (see Section II). These findings indicate that Aluminum Shapes is a PRP for the hexavalent chromium ground water contamination at the Puchack Well Field Superfund Site.

4. Fisher Development/Boise-Cascade, Inc.

Fisher Development Co. and Boise-Cascade, Inc. (collectively referred to hereafter as "Fisher Development/Boise-Cascade") were not named as PRPs for Puchack Well Field OU1 despite the history of chromium discharges at its Pennsauken site. It is likely that USEPA had an incomplete and incorrect picture of Fisher Development/Boise-Cascade's role as a PRP because it based its decisions on the data on ground water flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from the Fisher Development/Boise-Cascade site, coupled with the evidence of chromium discharges at its site reveals that Fisher Development/Boise-Cascade is a PRP for the contamination at issue in OU1.

a. Site Location and Industrial Operations Overview

The Fisher Development/Boise-Cascade facility is located at 875 Sherman Avenue, Pennsauken, New Jersey, across Bethel Avenue from the King Arthur facility and approximately 1800 feet southwest of Puchack Well # 6, as shown on Plate 1. The site has been owned by Fisher Development Co. since 1965. The site was developed as of 1967 and first occupied for industrial use by Keystone Millwork Co. from March 1967 until April 1974 under a sublease agreement with Chesapeake Industries, Inc., a Florida Corporation (Chesapeake Florida), the first site lessee. Boise-Cascade leased the site from April 1974 until August 1976 after acquiring the assets of Keystone Millwork from Chesapeake Industries, Inc., a Maryland Corporation, successor to Chesapeake Florida. The site then remained vacant until October 1977 when Winner Sales and Service, Inc. (Winner) began its tenancy of the site under a sublease agreement with Boise-Cascade. Boise-Cascade terminated its lease of the site in 1981. As of April 1981, the site was leased by Pacific Wood Products, Inc., which became Davidson Pacific Wood Products, Inc. (DPWP). Following a stock transfer and subsequent corporate restructuring, DPWP became Plywood Products, Inc. (PPI) in 1988. PPI vacated the property in February 1990.

With the exception of Winner, all site occupants from 1967 until 1990 produced wood paneling, with some entities also manufacturing wooden doors. For example, Keystone reportedly manufacturing pre-finished plywood panels and wooden doors, which entailed the use of unspecified paints and solvents. Boise-Cascade conducted similar operations, producing wall paneling from imported mahogany plywood, which underwent a color printing and embossing process to simulate wood graining. DPWP and PPI also manufactured plywood panels. According to its sublease agreement, Winner (subsidiary of Winner Chemical, Inc.) agreed to use the facility for the warehousing, distribution and light manufacturing, including blending, compounding and packaging of various chemicals such as powders, cosmetics and resins.

Information submitted by DPWP to the NJDEP as part of its proceedings in 1987 under New Jersey's former Environmental Cleanup Responsibility Act Environmental Cleanup Responsibility Act (ECRA) indicated that the facility was connected to the PSA system as of 1981. During the NJDEP's June 3, 1988 site inspection, the Department identified an underground pit that had not been identified in DPWP's ECRA submission. Based on information subsequently gathered, it was determined that certain industrial wastewaters had been discharged to this waste collection pit until 1978. DPWP later determined that the pit was 6 to 7 feet in depth and was of concrete-block construction with an earthen/sand floor (e.g., a dry well). Wastewater reportedly entered this pit via an underground line that received discharges from three floor drains and one sink drain within the building.

b. Remedial Investigations of Soil

As noted above, DPWP triggered the requirements of ECRA in 1987 (Case # 87A82). Based on information submitted to the NJDEP regarding the site, the Department required DPWP to obtain a soil sample from the base of the pit. Chromium was detected in that sample, obtained in 1989 from the upper six-inch soil interval, at 173 mg/kg, above the 100-mg/kg action level for chromium that the NJDEP was using at that time. Other constituents were also detected above then-current NJDEP action levels. No delineation soil sampling was apparently conducted. Based on those limited data, DPWP developed a Remedial Action Work Plan to address remediation of the pit via excavation and removal. The remedial action was implemented in September-October 1989 but was more extensive than initially contemplated due to the broader presence of VOC contamination than suggested by the initial soil sampling results. Delineation soil sampling was completed between April and August 1990 in proximity to the former pit location. Analytical results of those sampling efforts, which included sampling to depths up to 65 feet, identified a maximum chromium concentration of 25 mg/kg. Given though that these samples were collected beyond, but not at, the

perimeter of the excavated area, the data do not confirm that chromium soil contamination was effectively addressed during the 1989 soil remedial action. It is therefore possible the residual chromium soil contamination remains in this area.

c. Remedial Investigations of Ground Water

Ground water sampling was initiated at the site in August 1990 as part of ECRA investigations, with additional ground water sampling completed in February, September and October 1991, and in January and February 1992. Sampling was initially completed at five monitoring wells (MWs 1 through 5), with MW-6 and MW-7 installed in February 1991 for delineation purposes. Wells MW-8 and MW-9 were installed in September 1991 as part of supplemental characterization activities. These wells were generally completed to depths of 80 to 92 feet, although MW-1 was installed to a shallow depth of only 34 feet in an intermittent perched interval.

Total chromium was detected in August 1990 to a maximum concentration of 500 µg/l in MW-2, completed proximate to the former waste collection pit, with chromium also present at 120 µg/l in MW-4, located downgradient of the former pit. In its report regarding that sampling program (and the soil sampling completed in April-August 1990), Geotech Environmental, Inc., consultant to DPWP, indicated that there was an apparent nexus between chromium discharges to the pit and ground water contamination. Specifically, Geotech Environmental, Inc, concluded that "with the possible exception of chromium, no clearly obvious trend exists linking the metal content of the ground water samples to past discharges to the pit."

The February 1991 ground water sampling program included analyses for both total and hexavalent chromium but these analyses were, at the NJDEP's request, conducted on filtered samples (the August 1990 samples were not filtered). Chromium was not detected in the February 1991 sampling round.

A supplemental ground water remedial investigation was completed, initially through sampling of wells MWs 2, 4, 6 and 7 in September and October 1991. These wells were selected because they are at (MW2) and downgradient of (MWs 4, 6 and 7) the former waste collection pit. These ground water samples were analyzed for total and hexavalent chromium from both unfiltered and filtered samples. In the September 1991 unfiltered samples, total chromium was reported to a maximum concentration of 330 µg/l at downgradient well MW-4, and at concentrations between 22 and 69 µg/l at the other three wells. Lower total chromium concentrations were reported in the unfiltered samples from the October 1991 sampling round, with a maximum concentration of 68 µg/l reported (at MW-6). There was only one detection of total chromium in a filtered sample; 12 µg/l was detected in the September 1991 sample

from MW-4 (at which the highest chromium value was found in an unfiltered sample). No hexavalent chromium was detected in samples from either sampling round.

Two additional wells, MW-8 and MW-9, were installed in early 1992 to assist in the delineation of on-site chromium contamination. Available data indicates that these wells were samples in January 1992 (MW-8) and February 1992 (MW-8 and MW-9) for total and hexavalent chromium from both unfiltered and filtered samples. These data identified total chromium concentrations at MW-8 of 540 µg/l (January 1992) and 320 µg/l (February 1992), and 350 µg/l at MW-9 in February 1992 in the unfiltered samples. Total chromium was not reported in the filtered samples nor was hexavalent chromium detected in any of these samples. These data, in concert with the prior data from MWs 2, 4, 6 and 7, document a relatively extensive occurrence of chromium ground water contamination at the site.

In its June 1991 PRP memorandum regarding the site, the NJDEP indicated that the site was within the capture zone of the Puchack Well Field from 1973 until 1981. Even prior to the identification of widespread chromium impacts at the site in the more extensive ground water sampling beginning in late 1991, the Department also concluded that "a reasonable technical basis has been developed to conclude that discharges of chromium that occurred at the Davidson site are potentially responsible for pollution of ground water at the Puchack Well Field."

d. Conclusions

Intentional discharges of wastewaters to the ground occurred at the Fisher Development/Boise-Cascade site from as early as 1967 until 1978, when the Puchack Well Field was operational. These discharges resulted in impacts to soil and ground water at the site. In light of the known discharge of chromium to the environment from the facility, and the presence of chromium in ground water at the site, the Fisher Development/Boise-Cascade site likely contributed to chromium ground water contamination at the Puchack Well Field Superfund site. As noted above in Section II, ENVIRON has also confirmed that the site was within the capture zone of the Puchack Well Field during the relevant time period.

5. King Arthur, Inc.

King Arthur was not named as a PRP for Puchack Well Field OU1 despite its long history of discharging chromium at its Pennsauken site and through the compromised PSA sewer system. It is likely that USEPA had an incomplete and incorrect picture of King Arthur's role as a PRP because it based its decisions on the data on groundwater flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from the

King Arthur site, coupled with the evidence of chromium discharges at its site and through the leaky sewer system reveals that King Arthur is a PRP for the contamination at issue in OU1.

a. Site Location and Industrial Operations Overview

The King Arthur facility is located at 965 Bethel Avenue, Pennsauken, New Jersey, approximately 2,800 feet southwest of Puchack Well # 6, as shown on Plate 1. The site was owned by Continental Corp. from 1965 until January 1978, then by members of the Stevens family until at least 2000. King Arthur, Inc. leased the site from the owners from 1968 until 1986. Shelby Williams, Inc. purchased King Arthur's assets in October 1986, and subsequently moved site operations to Statesville, North Carolina. Operations ceased at the Pennsauken site on or about December 31, 1987.

King Arthur manufactured a line of party-rental folding tables, portable dance floors, portable electric turning platforms and stages using components produced by other manufacturers. Raw materials used on-site by King Arthur included cleaning and degreasing solutions, paint, different grades of plywood, Formica, Wilsonart (laminated and acrylic surfacing materials), steel parts, and metal joiners, including brackets, nuts, bolts, and screws.

As part of the assembly operations, King Arthur cleaned and painted metal parts. Prior to the 1986 acquisition by Shelby Williams, King Arthur cleaned and phosphated steel parts prior to painting. These operations entailed the use of three 1,600-gallon aboveground tanks holding the cleaning and phosphating solutions. The parts were treated in a dip-type process using a heavy duty detergent such as Oakite Cryscoat 187, a three-stage iron phosphate material for simultaneous cleaning and phosphating of steel prior to painting. This procedure cleaned oils from the metal framing and metalwork that went into the table support structure, with phosphating helping the paint adhere to the bare metal. The parts were then rinsed with tapwater. The final stage was to treat the parts with a chrome final rinse using Oakite FH, which was composed of chromic and mineral acids.

Prior to 1980, the wastewater and other contents of the three 1,600-gallon ASTs were reportedly routinely discharged (e.g., monthly) to the ground at the site. In particular, in a letter dated December 5, 1988 to King Arthur, the NJDEP indicated that discharge of 65,000 gallons per year of plating wastes directly to the soils had occurred at the King Arthur facility from the late 1960s until the mid 1970s. These tanks were sampled by the PSA in July 1980, identifying 320 mg/l of hexavalent chromium and 395 mg/l of total chromium. In addition, wastewater sludge from the phosphating process was also discharged to the ground surface during this timeframe.

b. Remedial Investigations of Ground Water

Ground water sampling was initially conducted by King Arthur at the site in February 1988 as part of ECRA investigations (Case # 86819), with additional ground water sampling completed in December 1989 and January 1990. Sampling was completed at five monitoring wells installed in the Middle Aquifer on or in proximity to the King Arthur site and three deep wells completed in the Intermediate Sand. These sampling programs indicated the presence of chromium to a maximum concentration of 3.69 mg/l in the deeper wells at the site (i.e., those screened in the Intermediate Zone from 140 to 190 feet), with elevated chromium concentrations not reported in the Middle Aquifer wells. According to an NJDEP memorandum dated June 29, 1990, the King Arthur site was within the estimated capture zone of the Puchack Well Field, and discharges of chromium that occurred at the King Arthur site were potentially responsible for pollution of ground water at the Puchack Well Field.

Two subsequent rounds of ground water sampling were conducted at the site in May and June 1991. The highest concentration of chromium detected during the June 1991 sampling event was 4.08 mg/l at well MW-3D, screened in the lower aquifer and located on-site immediately adjacent to site Building # 1. During this event, chromium concentrations of 0.1 mg/l and 0.95 mg/l were detected at upgradient well MW-5D and side-gradient well MW-6D, respectively.

In an internal memorandum dated August 14, 1992, the NJDEP noted that monitoring wells at the King Arthur site contained the highest concentrations of chromium detected in the vicinity of the Puchack Well Field. Additionally, the NJDEP indicated in an April 7, 1993 letter to Shelby Williams, Inc. that it had determined that ground water contamination found in the wells at the King Arthur site contributed to contamination discovered in the City of Camden's Puchack Well Field.

Based on email correspondence between the USGS and the USEPA dated March 2000, the USGS reportedly conducted sampling at the King Arthur site in 1998 and in Fall 1999. Hexavalent chromium was observed at well MW-3D located on-site at 1.82 mg/l. Hexavalent chromium was also detected at upgradient well MW5-D and side-gradient well MW6-D at concentrations of 0.93 mg/l and 0.298 mg/l, respectively, lower than concentrations detected at the King Arthur site.

The distribution of chromium concentrations in ground water over time at the King Arthur site is noteworthy for two primary reasons. First, despite the presence of hexavalent chromium at elevated concentrations in upgradient and side-gradient wells, corresponding on-site hexavalent chromium concentrations have consistently been markedly higher, indicating that there is an on-site source of hexavalent chromium contamination. Second, although there is evidence of an on-site hexavalent chromium

source, ground water conditions at the site have not been investigated to fully understand the extent to which on-site sources may have contributed to chromium ground water contamination at the Puchack Well Field. In particular, as indicated by the USGS in its March 15, 2000 email to USEPA regarding the King Arthur site, monitoring wells were not installed on the downgradient (i.e., southeastern) side of the building.

Ground water elevations measured at the site in 1991 indicate a south/southeasterly ground water flow direction, whereas an easterly direction of ground water flow is evident based on elevations measured in 1998. Under either scenario, the southeastern side of the building would be the downgradient side of the facility, yet shallow (i.e., Middle Aquifer) monitoring wells were not installed in that portion of the property. As such, any chromium migrating to, or originating from, that portion of the property would not have been identified. Further, the USGS noted that owing to the depth to ground water at this site (nearly 70 feet), releases of chromium-contaminated wastes could have migrated in multiple directions before impacting ground water. Consequently, the USGS expressed concern that the well network was insufficient to evaluate chromium ground water impacts from King Arthur. Accordingly, additional ground water sampling is needed at the King Arthur site to characterize the presence of site-related chromium contamination.

The distribution of chromium concentrations in ground water is illustrated by Figure 30 and cross section A-A' (Figure 31). The geometry of the chromium plume is consistent with the presence of additional sources of chromium other than SL in the vicinity of the King Arthur facility. Specifically, downgradient of SL attenuation of the plume is apparent; in the vicinity of the King Arthur site upgradient wells King Arthur MW-5, P MW-26M, and P MW-26I are found with lower chromium concentrations than on the King Arthur site (CC MW-1). Though the data are from a time period of different flow conditions than were present during the active pumping of the Puchack Well Field, expected chromium transport behavior would show attenuation with distance from a source. The observed distribution of chromium in ground water is consistent with the presence of additional sources of chromium to the plume at OU1.

c. Remedial Investigations of Soil

As noted above, prior to 1980, the contents of the three 1,600-gallon ASTS were reportedly routinely discharged (e.g., monthly) to the ground at the site, with wastewater sludge also disposed of on-site during this timeframe. Other unspecified hazardous substances were also reportedly discharged to the ground through a floor drain located in the paint room, which discharged directly into a french drain located adjacent to the building. According to a letter from King Arthur to the PSA dated

August 12, 1980, the degreasing and phosphating process was an integral part of operations at the King Arthur site, and the process had not substantially changed since operations began at the site in 1968. Therefore, King Arthur discharged chromic-acid bearing wastewaters (with hexavalent chromium concentrations of several hundred mg/kg, if not higher) to the ground surface for as much as a 12-year period of time.

The NJDEP was aware of the potential contamination that resulted from King Arthur's wastewater discharge practices, as documented in its December 5, 1988 letter to King Arthur regarding the on-site discharge to soils of 65,000 gallons per year of plating wastes from the late 1960s until the mid 1970s. Assuming that this volume of wastewater contained hexavalent chromium at the concentration of 320 mg/l noted above, ENVIRON calculated that King Arthur could have released more than 170 pounds of hexavalent chromium to the environment annually, or more than one ton of hexavalent chromium over the 12-year timeframe in which chromic acid was used on-site. Additional hexavalent chromium mass would have been released to the environment by King Arthur from its reported on-site disposal of wastewater sludge.

Soil sampling was conducted by King Arthur at the site in February 1988 as part of ECRA investigations (Case # 86819). This sampling revealed chromium concentrations up to 230 mg/kg in surface soils. Additional soil sampling was conducted to delineate those concentrations, which did not identify elevated chromium levels. However, the NJDEP noted in its December 5, 1988 letter that plating wastes do not always leave a trail of high-level soil contamination due to the high solubility of the associated contaminants (e.g., hexavalent chromium). Additionally, since several years had passed between cessation of King Arthur's wastewater releases to the ground and the evaluation of the site, the NJDEP noted that the degree of soil contamination could have significantly decreased due to the rinsing action of percolating rainfall while a significant ground water problem may persist in the aquifer below. The NJDEP therefore concluded that not having high levels of chromium contamination in soils at the King Arthur site was not necessarily indicative of having no ground water impacts at the site.

d. Conclusions

Intentional discharges of chromium-containing wastewaters to the ground occurred at the King Arthur site from at least 1968 to as late as 1980, when the Puchack Well Field was operational. Based on the volume of wastewater reportedly generated annually at the site, and the concentration of hexavalent chromium determined in at least one sample of that wastewater, King Arthur may have released more than one ton of hexavalent chromium to the environment during the 12-year period between 1968 and 1980 when chromic acid was used on-site, with additional hexavalent chromium

released to the environment via on-site disposal of wastewater sludge. These significant discharges resulted in impacts to ground water at the site, and also entered the PSA's sewer system through direct discharges (i.e., overflows). Ground water data collected at the site in 1991 revealed higher concentrations of chromium in ground water on-site than in upgradient and sidegradient wells, and the NJDEP determined that the site was within the capture zone of the Puchack Well Field. ENVIRON confirmed that the King Arthur site was within the capture zone during the relevant time period, as discussed above in Section II. Therefore, in light of the known discharge of substantial quantities of total and hexavalent chromium to the environment from the facility, and the presence of hexavalent chromium in ground water at the site, the King Arthur site likely contributed to hexavalent chromium ground water contamination at the Puchack Well Field Superfund Site.

6. MPC Industries, Inc.

MPC Industries, Inc. (MPC) was not named as a PRP for Puchack Well Field OU1 despite its long history of discharging chromium at its Pennsauken site. It is likely that USEPA had an incomplete and incorrect picture of MPC's role as a PRP because it based its decisions on the data on ground water flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from the MPC site, coupled with the evidence of chromium discharges at its site reveals that MPC is a PRP for the contamination at issue in OU1.

a. Site Location and Industrial Operations Overview

The MPC Industries, Inc. (MPC) site is located at 9111 River Road in Delair, New Jersey, approximately 4,000 feet north-northwest of the Puchack Well Field and across River Road from the Aluminum Shapes facility (see Plate 1). The MPC property was first developed for industrial use in 1953 and operated until January 2006 by various entities, primarily by MPC Industries (from 1970-1990 and 1998-2006) and its predecessor Mill Polishing Corp. (from 1963-1970) (collectively, "MPC") for the cutting, precision grinding and polishing of titanium, aluminum, stainless steel and exotic metal alloy sheet metal in the production of surface embossing templates. These operations also included the chromium electroplating and electropolishing, involving the use of hexavalent chromium-bearing chromic acid plating solution.

In late 1964 or 1965, a connection from the site to the PSA sewer system was reportedly established. Despite this connection to the sewer, however, MPC indicated in its November 2005 Preliminary Assessment Report (PA Report), as well as in earlier documents, that industrial wastewater was not released to the PSA system. Rather,

plating wastewaters were released to an on-site unlined lagoon constructed in the northeastern corner of the site. These discharges continued until 1979, when MPC ceased those plating operations (other plating operations began at the site in 1998).

Although meeting minutes of the PSA establish that MPC used an on-site septic system, MPC made no mention of that former septic system in its Industrial Site Recovery Act (ISRA) filings, an oversight that the NJDEP might identify during its review of MPC's PA Report. In light of MPC's assertion that it did not discharge plating wastewater to the PSA sewer system, it is likely that the plating wastewater was discharged to the septic system between approximately 1963, when MPC initiated operations at the site, and 1974 when the lagoon was decommissioned. It is further assumed any wastewater generated at the site by Wheatland Tube between 1953 and 1963 was also discharged to the septic system. Consequently, the on-site septic system received industrial wastewater discharges from circa 1953 to about 1974—exceeding a 20-year time span.

In the mid-1970s, MPC also experienced difficulties with sewage overflows at its site, particularly in the lobby area. The cause of these leaks was ultimately traced to the Aluminum Shapes facility, due to its long-term practice of releasing lard to the sewer lines, resulting in restricted flow and blockages to the sewer main servicing both Aluminum Shapes and MPC.

The facility was inactive from 1990 to 1998, at which time MPC completed facility upgrades and reinitiated industrial activities. MPC's operations from 1998 until the 2006 cessation of operations, continued to included chromium electroplating and electropolishing, involving the use of hexavalent chromium-bearing chromic acid plating solutions. MPC is currently remediating this property, pursuant to New Jersey's Industrial Site Recovery Act.

b. Remedial Investigation of Soils

MPC discharged industrial wastewater to the on-site lagoon beginning in or before 1974 and allegedly ceased those discharges sometime in 1979. Soil sampling was conducted at the former lagoon in 1990 and again in 1994, concurrent with evaluation of the swarf disposal areas discussed below. Chromium was identified in those soil samples to a maximum concentration of 1,440 mg/kg, although the sampling intervals (none deeper than 2 feet) do not appear to be of sufficient depth to encounter the former base of the lagoon or its underlying soils. No further investigation, and no active remediation, appears to have been conducted in the former lagoon area. Further, no soil sampling appears to have been completed near the former septic system, with MPC not even recognizing the existence of that system in its recent ISRA filings to the NJDEP.

In addition to wastewater discharged to the lagoon, MPC also disposed of solid

chromium-bearing solid waste on the property. MPC's former grinding operations generated swarf, an accumulation of fine metal shavings with cutting oil residues. Because mixed titanium and stainless steel swarf is reportedly pyrophoric, and thus not appropriate for on-road shipment, MPC obtained an NJDEP permit for on-site burning of the swarf, performing such burning from the mid-1960s until approximately 1990. In correspondence with the NJDEP from the late 1980s and 1990 regarding its swarf burning and disposal practices, MPC indicated that it could not locate a recycler for the burned swarf and therefore chose to dispose of the waste on-site in piles on unpaved portions of the property. MPC estimated that 2,700 cubic yards of this material had been disposed of at the site as of 1988. As the USEPA may be aware, the NJDEP reclassified certain oil-contaminated solid wastes in the late 1980s such that the oil-contaminated swarf became a New Jersey-designated hazardous waste. The swarf was therefore no longer appropriate for on-site burning and disposal without applicable RCRA permits. As such, the NJDEP compelled MPC to cease the on-site burning and disposal and proceed with the removal and off-site disposal of the accumulated burned swarf. The NJDEP allowed MPC to address the accumulated swarf waste at a measured pace, which would ultimately take approximately two years to fully remove (i.e., September 1990 through July 1992), with swarf-containing soils removed as of December 1993. Samples of the burned swarf were collected as early as December 1988, identifying chromium concentrations as high as 2,580 mg/kg, with associated surface soils having a maximum chromium concentration of 489 mg/kg. Following the remediation noted above, post-excavation soil sampling documented residual chromium concentrations as high as 1,560 mg/kg. In light of the continued presence of chromium and other metals contamination, MPC proposed additional sampling in its November 2005 PA Report. Implementation of that sampling appears to be pending.

Several other areas of potential soil and ground water impact are present at the site, particular those related to the former plating operations. For example, according to a March 1963 site drawing referenced in MPC's November 2005 PA Report submitted to the NJDEP, the plating operations involved use of a reinforced concrete pit, approximately 22' square and 6 to 9 feet deep. That pit was reportedly used until 1967, when it was filled with sand and capped with concrete. Although there is no specific information regarding the integrity of the pit at the time of its closure, in its November 2005 PA Report, MPC proposed no further action (NFA) for the pit based on its "substantial construction." MPC installed a replacement pit in 1972; this pit was 36 feet by 56 feet, and ranged in depth from 4 to 9 feet. It too was constructed of reinforced concrete, and also had "synthetic water stops" at the wall and floor joints. The pit remained open following removal of all plating equipment in 1979. MPC proposed NFA for this pit. A response from the NJDEP to these NFA proposals are pending and

thus, it appears that soil or ground water conditions associated with the former pits have not been evaluated. Potentially adverse soil and ground water impacts associated with the initial pit are of particular concern given that its construction does not appear to have included waterproof joint seals and no integrity inspection was performed before the pit was sealed. Additionally, areas of historical sewage overflows, likely impacted by chromium released to the sewers by Aluminum Shapes, have not yet been evaluated.

c. Remedial Investigation of Ground Water

Ground water conditions related to the former lagoon, septic tanks and other site features have not been investigated. Limited ground water sampling, however, was conducted at the site by The Glidden Company (successor to Devoe Coatings), operator of the industrial facility to the north, in or about 2004. That sampling included installation of five wells in the northern portion of the MPC site in the Upper Aquifer and two wells in the underlying PRM Aquifer (depths and aquifer zone not specified). Only the deeper wells were analyzed for metals, in March-April 2004, with chromium detected at concentrations of 72 and 86.4 μg/l. These data indicate that additional investigation of ground water is appropriate to determine the extent to which MPC's former site operations resulted in chromium contamination.

d. Conclusions

In light of the solubility of hexavalent chromium present in the chromic acid used and released to the environment by MPC for at least 16 years (i.e., from 1963 until 1979), in combination with the chromium ground water contamination identified at the site, it is likely that MPC's wastewater management practices resulted in chromium ground water contamination. Soils data from the site have documented elevated concentrations of chromium in the former lagoon area. Ground water data obtained by The Glidden Company at the MPC site have demonstrated that chromium ground water contamination is present on the MPC property, with additional ground water monitoring needed to evaluate the nature and extent of that contamination. Nonetheless, given the nature of MPC's industrial operations and wastewater management practices, there is sufficient evidence indicating that MPC released chromium to the environment and may have contributed to hexavalent chromium ground water contamination at the Puchack Well Field Superfund Site. ENVIRON has also confirmed that the MPC site was within the capture zone of the Puchack Well Field during the relevant time period (see Section II).

7. Penler Anodizing

Penler Anodizing, Inc. (Penler) was not named as a PRP for Puchack Well Field OU1 despite its long history of discharging chromium at its Pennsauken site and through the compromised PSA sewer system. It is likely that USEPA had an incomplete and incorrect picture of Penler's role as a PRP because it based its decisions on the data on groundwater flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from the Penler site, coupled with the evidence of chromium discharges at its site and through the leaky sewer system reveals that Penler is a PRP for the contamination at issue in OU1.

a. Site Location and Industrial Operations Overview

The former Penler facility is located at 1400 Suckle Highway, approximately 2,800 feet northeast of the Puchack Well Field (see Plate 1). Wetler Corporation initiated industrial operations at the site in approximately 1960 or 1961, with Penler taking over operations of a portion of the site in 1965. Available information regarding its industrial operations indicates that Penler conducted zinc electroplating and anodizing at the site, each process utilizing 19 dip and rinse tanks in series. As part of each of these processes, Penler used M&T Unichrome Dip Compounds 1605, a solution containing chromic acid. This solution was used in the zinc electroplating line as a "running rinse," Prior to 1987, waste chromic acid tank drainage was discharged to an exterior storage tank to a floor drain, which discharged to an outside pit, and then eventually to the PSA. Wastewater generated prior to that time was discharged to the PSA system without any such chromium conversion or other pretreatment. After 1987, wastewater was treated on-site in a chromium conversion unit to convert hexavalent chromium to trivalent chromium prior to discharge to the PSA sewer system.

b. Remedial Investigation of Soils

As noted in its April and May 1985 inspection reports of the Penler site, the NJDEP Division of Water Resources, Bureau of Southern Regional Enforcement observed that rather than being released directly to the PSA sewer system, the plating wastewater was first discharged to an open exterior pit from which the wastewater flowed into an open/broken pipe leading to the PSA system. Owing to these observations, the NJDEP directed Penler to cease "illegal ground discharge to the sanitary sewer." During the May 16, 1985 inspection, the NJDEP collected samples from an interior sump pump pit (hexavalent chromium at 15,000 µg/l) and from the exterior discharge pit (404 µg/l). The NJDEP also collected soil samples on October 10, 1985 adjacent to the pit and from sediment in two trenches inside the building. Chromium concentrations near the exterior pit ranged from 278 mg/kg in the soil surface to 65 mg/kg at nearly 3 feet; chromium was also detected at 1,000 mg/kg in one of the interior trench samples.

Penler also collected soil samples at the site, including on February 6, 1986 in preparation for construction of a building addition for a planned wastewater pretreatment facility. That sampling documented hexavalent chromium concentrations, following sample extraction by the EP Toxicity leaching method, of 129 to 229 mg/l. Given that the EP Toxicity leaching procedure entails dilution of one volume of soil sample with 20 volumes of an acidic solution, and analysis of the resulting leachate, these results indicate that hexavalent chromium was present in the original soil samples at concentration at least 20 times the leachate results, or minimally 2,580 to 4,580 mg/kg. The NJDEP discussed Penler's sampling results in a June 26, 1986 draft letter to Penler and in a July 15, 1987 final letter, evaluating the data relative to "Action Levels for the Cleanup of Contaminated Soils", including an action level of 100 mg/kg for total chromium. In particular, the Department indicated in its July 15, 1987 letter that the total chromium standard was exceeded in the surface samples from four locations and at 2-4 feet at two other locations, and further noted that "we also recognize that the existing soil contamination may be contributing to the contamination of the ground water of the State." In a handwritten insert to the June 1986 draft letter, it was further noted that the hexavalent chromium soil contamination was derived in part from overflows from a sump that received process wastewater and "an illegal wastewater discharge pipe", as well as poor housekeeping and a floor drainage system. Based on these results, the NJDEP directed Penler to conduct soil remediation prior to building construction.

Penler informed the NJDEP in 1987 and 1988 that because of its decision to construct the pretreatment facilities at an interior location, and because of its limited resources, it had been unable to proceed with the soil remediation and testing required by the NJDEP. ENVIRON reviewed no documentation indicating that chromium contamination was delineated, as the NJDEP required (most recently in a December 12, 1990 letter to Penler), or that this contamination was remediated. Records of NJDEP inspections of the site indicate Penler's consistent practice of discharges to the environment. Specifically, in an internal memorandum of June 28, 1990 regarding Penler's potential contribution of hexavalent chromium to the Puchack Well Field, the NJDEP noted that the discharge to ground of wastewater from the degreasing tank "appears to be an integral part of production operations…and may be equal in duration to Penler's tenancy at the site." In light of this and comparable observations, it is reasonable to conclude the releases of industrial wastewaters to the environment occurred on a regular basis at the Penler site, likely beginning when Penler initiated its plating operations at the facility. As indicated below, chromium was present at markedly elevated concentrations in Penler's wastewater discharges.

In 1999, Marathon Engineering and Environmental Services. Inc. collected soil

samples for chromium analyses on behalf of Penler from two areas of concern (AOCs). These AOCs, and the associated maximum chromium concentrations, included: (1) AOC 4 (Floor Drains/Cracked Floor/Sanitary Sewer Piping in Building C, the Electroplating Room), with 251 mg/kg chromium; and (2) AOC 7 (interior concrete pit with clay bottom), with chromium to 595 mg/kg. Based on these data, Penler proposed remedial investigation activities, although it is unclear if that additional sampling was performed. These additional data would be necessary to evaluate the nature and extent of the chromium soil contamination in these areas.

c. Remedial Investigation of Ground Water

At least one ground water sample was obtained from Penler's former production well, screened from 75 to 80 feet in depth. That sample, collected by the NJDEP on October 10, 1985, identified hexavalent chromium at a concentration of 23,000 μg/l.

Documentation reviewed by ENVIRON regarding the Penler site indicates that the NJDEP had substantial concerns regarding ground water quality at Penler, and about the impacts of Penler's operations on regional ground water quality (i.e., to the Puchack Well Field). Nonetheless, despite the NJDEP's recommendations that ground water sampling be performed at the site, there is no information indicating that Penler completed any ground water monitoring. Although remedial investigation of ground water was proposed in 2000 as part of the Industrial Site Recovery Act proceedings under Case #E99012 for Wetler Corporation, the prior site operator, the record does not include documentation indicating that such sampling was performed.

d. Conclusions

Penler: (1) handled hexavalent chromium-bearing materials on-site; (2) handled those materials in a manner that caused releases to the environment, resulting in markedly elevated hexavalent chromium concentrations in soils; and (3) may have adversely impacted ground water. In light of the above information, there is sufficient evidence indicating that Penler released chromium to the environment and likely contributed to hexavalent chromium ground water contamination at the Puchack Well Field Superfund Site. ENVIRON has also confirmed that the Penler site was within the capture zone of the Puchack Well Field during the relevant time period (see Section II).

8. Weyerhaeuser Company, Inc.

Weyerhaeuser Company, Inc. (Weyerhaeuser) was not named as a PRP for Puchack Well Field OU1 despite the long history of chromium discharges at the Pennsauken site. It is likely that USEPA had an incomplete and incorrect picture of Weyerhaeuser's role as PRPs because it based its decisions on the data on groundwater flow and zone of influence that was limited by the fact that only the year 1995 was modeled by USGS. The new data showing capture by the Puchack Well Field of discharges from the Weyerhaeuser site, coupled with the evidence of chromium discharges at its site reveals that Weyerhaeuser is a PRP for the chromium contamination at issue in OU1.

a. Site Location and Background

The Weyerhaeuser site is located at 7200 Westfield Avenue in Pennsauken Township, New Jersey, approximately 1,500 feet southeast from Well #6 at the Puchack Well Field, the first well at which chromium contamination was identified. The property appears to have been developed for industrial use in or about 1947. Kieckheffer Container Co. (Kieckheffer) occupied the site from 1947 and manufactured corrugated containers at the site. Kieckheffer subsequently merged with Weyerhaeuser, who occupied and operated the site from 1959 through 1978 for the printing and sealing of milk cartons. Weyerhaeuser ceased operations in 1979 and the site was vacant until 1984. Weyerhaeuser sold the property to Realty Group Associates (RGA), formed by the principals of Mercon Industries, Inc. (Mercon) in August 1984. Mercon operated at the site from 1984 until September 16, 1986 for the manufacture of displays and exhibits, including graphic arts and audio visuals. Bohem Manufacturing Co. (Bohem) leased the site from Mercon and operated at the site from 1987 until 1990 for the assembly of glass and acrylic skylight window products. Bohem sublet portions of their leasehold to Parks Distribution for approximately six months during 1990 and to Knecht, Inc. (office portion only) in August 1990 for administrative operations. As of September 1994, the site has been owned and occupied by the Life in Christ Ministry.

The property was evaluated as part of proceedings ECRA statute in 1984 by following Weyerhaeuser's sale of the site to Mercon (ECRA Case No. 84166). In 1987, Mercon had to undergo ECRA due to its cessation of operations (ECRA Case No. 87550) and in early 1989 related to Mercon's sale of the site to Bohem (ECRA Case No. 89451). As part of each of those ECRA proceedings, Weyerhaeuser and Mercon submitted information to the NJDEP indicating that no industrial activities or features had been identified at the site that could have resulted in releases of hazardous substances to the environment. Accordingly, each party proposed no further action at the site. Based on those representations, the NJDEP approved a Negative Declaration for each ECRA matter such that no intrusive investigations were required.

b. Remedial Investigation of Ground Water

In 1989, shortly after its approval of the third Negative Declaration for the site, the NJDEP conducted a review of historical aerial photographs from 1951 through at least 1979 for the vicinity of the Puchack Well Field, including the Weyerhaeuser property. Based on this review, the NJDEP identified an unlined lagoon[6] and an associated connecting ditch in the southwest corner of the Weyerhaeuser site, features not previously identified by Weyerhaeuser or Mercon as areas of concern under the ECRA cases noted above. In the aerial photographs reviewed by the NJDEP in 1989, the retention basin appeared to be partly filled with liquid in some photographs, and empty in others. Precipitation data were evaluated in conjunction with historical aerial photographs, and it was concluded that the liquid apparent in the lagoon was not entirely derived from storm water, as evidenced by liquid visible in the lagoon on dates with no recently recorded local precipitation.

In light of these observations and soil analytical results discussed below, the NJDEP rescinded the Negative Declaration approvals previously granted to Weyerhaeuser and Mercon, and required both parties to investigate the lagoon. Consequently, Mercon/RGA conducted a historical research of site operations to determine the history of lagoon use. RGA notified Weyerhaeuser in a July 19, 1990 letter that based on RGA's historic operations research and document review, it was evident that blue liquids (waste products from printing inks) were periodically discharged from the building to the ditch and lagoon during Weyerhaeuser's prior operations. Additional information regarding historical releases to the lagoon are available in internal Weyerhaeuser communications discussed below.

Available documentation regarding Weyerhaeuser's site activities indicate that chromium-bearing materials were used as part of its industrial operations and likely released to the lagoon. These documents, obtained from USEPA, were prepared by Weyerhaeuser related to its attempts in the early 1970s to sell the "surplus" property (i.e., the approximately 4 to 7 undeveloped acres of the site, which included the lagoon). Specifically, in internal memoranda from February and March 1971, Weyerhaeuser indicated that the lagoon, which was approximately 60' x 150' x 8' deep, served as a retention basin for storm water from the plant roof, as well as wastewater from plant floor drains, the laboratory and certain wash-up points located in the manufacturing area. At that time, the lagoon was not connected to the PSA's domestic sewer line, and Weyerhaeuser was investigating whether discharges should be diverted to a new basin (should the parcel on which the lagoon was located be sold to a third party) or to the

[6] The lagoon was identified as a retention basin in Weyerhaeuser's and Mercon's ECRA filings to the NJDEP, which implies its use for storm water retention. However, as discussed herein, this feature received process wastewater from the facility and is therefore referred to in this report as a lagoon, consistent with the terminology used by the NJDEP to describe the feature.

township's storm sewer. Weyerhaeuser entered into contract negotiations to sell the "surplus" property to the adjacent property owner, The Rogers Enterprises. However, contract negotiations between the parties terminated because Rogers would not grant Weyerhaeuser an easement through the property for Weyerhaeuser's portion of a proposed storm sewer. In a February 10, 1972 memorandum regarding this termination of negotiations, David Judkins of Weyerhaeuser noted that "Since Rogers brought up this matter in the first place, his refusal to give us any sort of an easement is baffling. I am now apprehensive that he might draw the attention of Pennsauken sanitary officials to the lagoon. Let's hope he doesn't."

On August 30, 1989, the NJDEP Southern Bureau of Regional Enforcement conducted an inspection of the Weyerhaeuser site to evaluate the lagoon location. Perched shallow ground water was encountered by the NJDEP at a depth of 18 inches below the base of the lagoon. A sample of that perched water collected by the NJDEP contained chromium at 470 ug/l.

On September 12, 1990, NJDEP's Industrial Site Evaluation Element inspected the site due to an additional ECRA triggering event, namely the cessation of operations and sale of assets due to bankruptcy of Bohem. On September 21, 1990, NJDEP issued a letter to Weyerhaeuser and Mercon to submit a schedule for addressing the lagoon. In January 1991, Weyerhaeuser submitted a sampling plan to address the lagoon and agreed to enter into an Administrative Consent Order (ACO) with the NJDEP.

In internal memorandums dated February and July 1990, the NJDEP documented that the Weyerhaeuser site is located within the capture zone of the Puchack Well Field, and the lagoon is located approximately 1,500 feet from the first well (Well # 6) to become contaminated in the Puchack Well Field. Based on the findings of the aerial photograph review, historical operations research, and shallow soil and perched ground water sampling within the lagoon, the NJDEP concluded in a memorandum dated August 1990 that a reasonable technical basis has been developed to conclude that discharges of chromium that occurred at the Weyerhaeuser site are potentially responsible for contamination of the Puchack Well Field.

The distribution of chromium concentrations in ground water is illustrated by Figure 30 and cross section A-A' (Figure 31). The geometry of the chromium plume is consistent with the presence of additional sources of chromium in the vicinity of the Weyerhaeuser site. Specifically, in the vicinity of the Weyerhaeuser site, upgradient wells P MW-14 and P MW-14I are found with lower chromium concentrations than wells on the Weyerhaeuser site. Though the data are from a time period of different flow conditions than were present during the active pumping of the Puchack Well Field, expected chromium transport behavior would show attenuation with distance from a

source. The observed distribution of chromium in ground water is consistent with the presence of additional sources of chromium to the plume at OU1.

In a February 1992 sampling round, chromium was detected at a maximum concentration of 130 µg/l in on-site monitoring well P-1. Weyerhaeuser collected four quarterly rounds of ground water samples from six monitoring wells following completion of the soil remediation program (discussed below) in the vicinity of the former on-site wastewater lagoon. Chromium was detected in downgradient monitoring well P-1 at levels of 102 µg/l and 142 µg/l during the first and third quarters of ground water monitoring conducted in October 1993 and April 1994, but was not detected during the second and fourth quarterly monitoring events conducted in January and September 1994. Based on field sampling parameters data reviewed by ENVIRON, the presence of chromium in these ground water samples does not appear to be related to sample turbidity or other conditions that are not related to actual ground water conditions.

c. Remedial Investigation of Soils

In internal documentation, Weyerhaeuser described analytical results of five samples collected in April 1991 by Glenn Wickett, general manager of the facility from 1974 to 1979 (per EPA000909). These samples, apparently analyzed only for chromium, included four soils (with results between 500-1,000 mg/kg) and one "slag" sample (41,700 mg/kg). These samples were also tested for RCRA metals by the Toxicity Characteristic Leaching Procedure (TCLP), with chromium results in soils of 0.02-0.10 mg/l and in the slag sample at 0.49 mg/l. The nature of the slag sample is not discussed in available documentation for the site, but these data nonetheless indicate that media with significantly elevated chromium concentrations had been discharged at the site.

On August 30, 1989, the NJDEP Southern Bureau of Regional Enforcement conducted an inspection of the Weyerhaeuser site to evaluate the lagoon location. During that inspection, the NJDEP observed blue-stained near-surface soils, and collected soil samples from the surface and from a depth of 6 to 12 inches from the lagoon and the associated ditch. All samples were analyzed for Priority Pollutant metals and VOCs. Chromium was detected in these samples to a maximum concentration of 1,150 mg/kg. A letter from J.M. Huber Corporation to Weyerhaeuser dated October 4, 1976 indicates that Kraftset and Huberflex inks (presumably used by Weyerhaeuser) contained lead, copper, chromium, molybdenum, and phosphorus.

A remedial investigation conducted by Weyerhaeuser in 1992 pursuant to the ACO identified seventeen areas of concern (AOCs). Fifty one shallow soil borings (less than 3 feet deep) were completed in the retention basin and the drainage ditch leading to the

retention basin. Out of a total of 86 soil samples, chromium was detected in 10 samples at levels exceeding the former ECRA standard of 100 mg/kg, at a maximum concentration of 1,880 mg/kg in a sample from 0 to 1 feet. All exceedances were noted in samples from the trench leading to the retention basin or from samples taken from the center of the trenches that form the U-shaped basin.

In addition to the retention basin, metals were also detected in three additional areas on-site. Sediment samples present in the western exterior holding tank (AOC 10) and the western exterior grease pit (AOC 11). The water in these two areas did not contain chromium at levels exceeding the ground water quality standards. Chromium was detected at a maximum concentration of 265 mg/kg in a sludge sample from the exterior holding tank. Sediments in both AOCs were removed and disposed off-site along with the water. Metals were also detected in sediment samples present in the eastern interior dry well (Area 17, not an AOC defined by the NJDEP). Sediments were removed to the bottom of the sidewalls of the drywell, and water and sediment in the drywell were appropriately disposed.

Based on these findings, Weyerhaeuser excavated and disposed off-site approximately 300 cubic yards of contaminated sediments from the lagoon in 1992. Soils were removed to a depth of 1 foot below any evidence of blue coloration, which previous sampling had determined to be correlated with soil contamination. None of the post-excavation soil samples contained chromium at levels exceeding the direct contact soil cleanup criterion of 500 mg/kg for chromium. Chromium concentrations of up to 25 mg/kg were detected in the post-excavation samples taken at 6-inches below excavation grade.

d. Conclusions

Discharges of chromium-containing wastewaters to the lagoon occurred at the Weyerhaeuser site from at least 1959 until 1978, which resulted in impacts to soil and ground water at the site. These historic discharges occurred in a timeframe when the Puchack Well Field was operational. Additionally, the NJDEP determined that the site was within the capture zone of the well field. These data therefore indicate that the Weyerhaeuser site likely contributed to the chromium contamination of OU1 of the Puchack Well Field Superfund Site. As discussed above in Section II, ENVIRON has also confirmed that the Weyerhaeuser site was within the capture zone of the Puchack Well Field during the relevant time period.

IV. CONCLUSIONS

Based on the assessment presented herein, there is abundant evidence to indicate that the following facilities should be considered PRPs for the chromium contamination at OU1 of the Puchack Well Field Site.

- Pennsauken Landfill
- Aluminum Shapes, Inc.
- King Arthur, Inc.
- MPC Industries, Inc.
- Penler Anodizing, Inc.
- Weyerhaeuser Company, Inc.
- Fisher Development Co./Boise-Cascade, Inc.

Portions of the Pennsauken Sewer System with questionable integrity convey chromium wastewater within the Puchack Well Field capture zone. As outlined in Section II, the age and condition of these conveyances indicate that discharge from these conveyances would have resulted in discharge of chromium to ground water. Further, sludge handling practices at the PSA Sewage Treatment Plant also likely contributed chromium to ground water captured by the Puchack Well Field. Therefore, there is abundant evidence to indicate that the following additional industries and facilities should be considered PRPs for the chromium contamination at OU1 of the Puchack Well Field Superfund Site.

- CJ Osborn Chemicals Inc./Cook Composite
- Superior Varnish Co.
- Donut Management
- Garden State Motors, Inc.
- Natico, Inc.
- DeSoto, Inc.
- Reconditioned Motor Parts, Inc.
- Elco Varicircuits
- United Steel and Wire
- Pennsauken Sewerage Authority

APPENDIX A

List of Primary References

APPENDIX A

Source of Information

In performing this assessment, ENVIRON obtained information from documents in the Administrative Record, including but not necessarily limited to the following:

1992 Fourth Quarter Diversion Report and Updated Reponses to Conditions 5, 7, 12 and Status of Abandoned Wells, City of Camden Department of Utilities, dated January 22, 1993.

A list of past/present industrial operations that discharged industrial wastewater into the municipal sanitary sewer system, provided by Counsel.

Advanced Environmental Solutions, LLC. Chromium Remediation Investigation Report for Aluminum Shapes, L.L.C. March 2002.

Analytical Data, Century Environmental Testing Labs, Inc. for the Pennsauken Sewerage Authority for the King Arthur facility, Bates No. P-A06577-8, undated.

Arcadis G&M, Inc., Remedial Action Workplan for the Pennsauken Sanitary Landfill, August 2005.

Barton, G. J., and M. Krebs, Hydrogeologic reconnaissance of the Swope Oil Superfund Site and vicinity, Camden and Burlington Counties, New Jersey: USGS OFR 89-402.

Camden County Municipal Utilities Authority, 201 Facilities Planning for Sludge Management – Treatability Studies Final Report Part II, Greeley and Hansen, dated September 1979.

Camden County Municipal Utilities Authority, Infiltration/Inflow Analysis for Service Area 34, Pennsauken Township and Merchantville Borough, District II- Delaware Basin, by Weston, Speitel, Watermation, dated November 1979, revised March 1980. ("Weston 1980").

CDM, 1985, Summary of conclusions and recommendations of chromium contamination analysis at Puchack Well Field Camden, New Jersey: Boston, Mass., unpublished consultant's report, 144 p.

Edward J. Sikora, ASTM and the National Clay Pipe Institute, ASTM Standardization News, August, 2004

Eckel J.A. and R.L. Walker, Water levels in major artesian aquifers of the New Jersey Coastal Plain, 1983: USGS WRIR 86-4028.

Electronic Files resulting from FOIA request of USGS provided by Counsel.

Final Operable Unit 1 Remedial Investigation Report Puchack Well Field Superfund Site Remedial Investigation/Feasibility Study (RI/FS) Pennsauken Township 2006. CDM 2006.

James C. Anderson Associates, Inc. Ground Water Investigation, Pennsauken Sanitary Landfill Site. December 1988.

James C. Anderson Associates, Inc. Expanded Remedial Investigation Report. May 1990.

James C. Anderson Associates, Inc. , Feasibility Study – Pennsauken Sanitary Landfill, May 1993.

Letter to Aluminum Shapes from the New Jersey State Department of Health, Water Pollution Control Program, dated April 18, 1968.

Letter regarding Penler Anodizing to Ms. Carol Osborn, NJDEP Southern Bureau of Regional Enforcement from J.E. Rhodes Associates, dated April 2, 1986.

Letter (partial, draft #2) to Mr. William Duncan, President of Penler Anodizing, from the NJDEP regarding Soil Contamination at Penler Anodizing, Inc., dated June 26, 1986 and bearing Bates No. P-A10087 through P-A10090.

Letter to Mr. William Duncan, President of Penler Anodizing, from the NJDEP, dated December 12, 1990.

Letter from Robert S. Nicholson of the USGS to Akshay Parikh Bureau of Site Management, Dated May 5, 1998. Subject: Preliminary water-level survey report, Pennsauken Project and enclosure: "Effects of Pumping Puchack Well #1 on the localized direction of ground-water flow in the lower aquifer of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township, NJ"

Letter to Weyerhaeuser Company, Inc. from J.M. Huber Corporation dated October 4, 1976.

Leonard Metcalf and Harrison P. Eddy, American Sewerage Practice, 1914

Leonard Metcalf and Harrison P. Eddy, Sewerage and Sewage Disposal, 1922

Leonard Metcalf and Harrison P. Eddy, Sewerage and Sewage Disposal, 1930

Memorandum re: Puchack, Morris and Delair Well Fields, Pennsauken Township Camden County, Ground Water Pollution Assessment Audit, prepared by Robert Gallagher, New Jersey Department of Environmental Protection (NJDEP), Division of Water Resources, Bureau of Ground Water Pollution Assessment dated February 28, 1990.

Memorandum re: Puchack Well Field, Pennsauken Township Camden County, Potentially Responsible Party Determination Pennsauken Landfill, prepared by Robert Gallagher, New Jersey Department of Environmental Protection (NJDEP), Division of Water Resources, Bureau of Ground Water Pollution Assessment dated April 30, 1991.

Memorandum re: Potential Sources of Chromium Contamination prepared by Donna Gaffigan, New Jersey Department of Environmental Protection (NJDEP) Bureau of Planning and Assessment; dated September 29, 1987.

Metcalf & Eddy, Inc., Wastewater Engineering, Collection Treatment and Disposal, 1972

MPC Industries, Inc. Preliminary Assessment Report. November 2005.

Navoy, A.S., and Carleton, G.B., 1995, Ground-water flow and future conditions in the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey: New Jersey Geological Survey Report GSR 38, 184 p.

NJDEP internal memorandum from Joe Douglass, Region VI to Dick Dalton, Division of Water Resources, dated February 10, 1983.Notice of Termination of Service to United Steel and Wire Company from The Pennsauken Sewerage Authority, dated August 24, 1988.

Pennsauken Sewerage Authority TV Inspection Reports, prepared by Richard A. Alaimo Associates, Consulting Engineers, dated June and July 1994.

Pennsauken Sewerage Authority letter to Mr. James K. Hamilton, NJDEP, dated May 18, 1984.

Pennsauken Sewerage Authority letter to Mr. James K. Hamilton, NJDEP, dated February 25, 1985.

Pollock, D.W., 1994, User's guide for MODPATH/MODPATH-PLOT, version 3: A particle-tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model: U.S. Geological Survey Open-File Report 94-464.

Pollution Control Financing Authority of Camden County. Bid Specifications for Guaranteed Fixed Pricing for Remediation for Facility 0427A at the Pennsauken Sanitary Landfill. August 9, 2004.

Pope, D.A. and M. K. Watt, Use of a ground-water flow model to delineate contributing areas to the Puchack Well Field, Pennsauken Township and vicinity, Camden County, New Jersey: USGS SIR 2004-5101

Pope, D. A. and M.K. Watt, Simulation of ground-water flow in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey, USGS SIR 2004-5025.

Remington Engineers. Report to the Pennsauken Sewerage Authority on Cleaning, Repairing & Televising of Existing Sanitary Sewer Mains. October 20, 1982.

Remington Engineers. Sanitary Sewer System Inflow & Infiltration Study – Township of Pennsauken, September 1983.

Robert S. Amick and Edward Burgess, Exfiltration in Sewer Systems, USEPA, Water Supply and Water Research Division.

Roux Associates, Inc. Supplemental Chromium Remediation Investigation Report for Aluminum Shapes, L.L.C. July 2005.

Survey of Camden County, 2002, Camden County Historical Society

Tabulated Wastewater Monitoring Data from 1983-1984, Alaimo Document Production – CED-ROM #02391-02428.

Todd Giddings and Associates, Potential Effects of the Proposed Pennsauken Township Landfill on the City of Camden's Water-Supply Wells, April 1980.

USEPA, Design Manual for Dewatering Municipal Wastewater Sludges, USEPA, 1982.

USEPA, Design Manual for Dewatering Municipal Wastewater Sludges, USEPA, 1987.

USEPA, Office of Water, Municipal Facilities Division, Results of the Evaluation of Ground water Impacts of Sewer Exfiltration, 1989.

Walker, R.L., 2001. Effects of Pumping on Ground-Water Flow Near Water-Supply Wells in the Lower Potomac-Raritan-Magothy Aquifer, Pennsauken Township, Camden County, New Jersey. U.S. Geological Survey Water-Resources Investigations Report 00-4012).

Walker, R.L., and Jacobsen, E.J., 2004, Reconnaissance of hydrogeology and ground-water quality Pennsauken Township and vicinity, Camden County, New Jersey, 1996-1998: U.S. Geological Survey Water-Resources Investigations Report 03-4247, 102 p.

Woodward-Clyde. Letter to M. Morrison of the New Jersey Department of Environmental Protection regarding the Weyerhaeuser/Mercon site. September 15, 1994.

Zapecza, O.S. Voronin L. M., Martin, M., Ground-water-withdrawal and water-level data used to simulate regional flow in the major coastal plain aquifers of New Jersey: USGS WRI 87-4038.

FIGURES

PLATES